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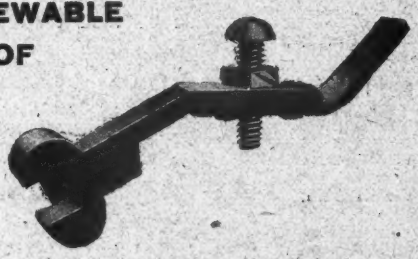

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THE
ELECTRICAL REVIEW.

VOL. LXXX. MAY 11, 1917. No. 2,059.

ELECTRICAL REVIEW

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THE I.E.E. REPORT.

THE publication of the annual report of the Institution marks the approaching termination of the session so far as meetings of members are concerned, but by no means signifies the end of the year's work to the Council and Committees. Last year, according to the report, the Council met 16 times, and the Standing and other Committees held no fewer than 122 meetings; as many of the members sit on several of the Committees, and on the Council as well, it will be seen that service on these bodies is no sinecure, but, on the contrary, calls for considerable personal sacrifice. While no very remarkable events have characterised the period covered by the Report, the Council is to be congratulated on the solid work accomplished during the year, and on the progress which it has made in the direction of serving the interests of its members and of the electrical industry more effectively, under the energetic guidance of the President, Mr. C. P. Sparks, whose term of office has been, perhaps, the most strenuous and exacting of any in the history of the Institution.

Amongst the principal events of the past year have been the consummation of the movement towards the expunction of the names of alien enemies from the list of members; the lamented death of Dr. S. P. Thompson, a misfortune that cannot be repaired; the appointment of the Committee on Electricity Supply; and the adoption of the important series of recommendations submitted by the President on behalf of the Council to the Electrical Trades Committee of the Board of Trade.

The Committee on Electricity Supply has been awaiting the publication of the report of the Electrical Trades Committee in order to "work as far as possible along the lines which it was anticipated would be indicated therein." In this remark is clearly implied an expression of surprise at the inexplicable delay in publication of the report, which was understood to be practically ready weeks ago; veiled protests may be appropriate to the report of the Institution Council, but do not go far enough for us—we regard it as extremely unfortunate that this important matter should be held up so long. Who is responsible for the delay? It may be that some hidden influence is at work to hinder the publication of the report or to obtain some modification of its terms, and we trust that every effort will be made by the Council of the Institution and other bodies concerned to bring the matter to a head. On the other hand, we fail to see why the I.E.E. Committee should mark time so patiently; so far as we can see, while the National Electric Supply Joint Committee appointed by the I.M.E.A. and the I.A.E.P.C. has been getting on with its work of organisation, and has set the machinery in motion towards linking-up in various districts, the I.E.E. Committee has apparently effected little beyond selecting standard frequencies for certain districts (50, 40, and 25, at a guess), and has now adopted the discredited "Wait and see" policy which so nearly lost the war for us. The Committee will "proceed with their deliberations"—truly an apt expression; surely we may hope for something more definite, more energetic, than is suggested by the present attitude of the Committee. This is a time not for "deliberation," but for prompt and vigorous action.

We congratulate the Council and the Committees of Local Sections upon the excellent work that is

being done towards enabling disabled sailors and soldiers to secure employment as sub-station and switchboard attendants. Our hearts go out to these brave fellows who have paid so heavy a price for the freedom of their country, and we are especially pleased to see that the efforts of our leaders are being so well supported by central-station managers that the applications for men out-number the candidates for employment by more than two to one. Before the return of peace the number of men to be provided for will be far greater, and increased facilities for training them will be urgently required. This is a work which deserves the heartiest encouragement from all who are in a position to assist in pressing it forward.

We are glad to see, too, that the Institution took prompt action in the emergency created by the memorandum of the Reserved Occupations Committee, which threatened to cripple the supply of electricity to factories engaged upon the manufacture of munitions of war. It is, no doubt, difficult for laymen to appreciate the exceptional conditions obtaining in the electricity supply industry—the extremely small number of men employed in comparison with the magnitude of the operations carried on, and the imperative necessity of their being highly skilled men who cannot possibly be replaced by unskilled labour, still less by women, except in minor posts. An excess of zeal on the part of the military authorities might easily lead to irreparable consequences if not checked before the mischief was done, and it was fortunate that the Institution, in alliance with the I.M.E.A. and other representative associations, was able to secure the reconsideration of the Committee's ill-advised decision.

Lastly, we pay a tribute of respectful admiration to the 1,671 members of the Institution who have joined the Colours in defence of the Realm—more than a quarter of the total membership. This is indeed a splendid record, which is enhanced by the long list of distinctions already awarded to members, and the sad but glorious Roll of Honour engraved upon the memorial panels in the hall of the Institution.

Engineering Labour and the War.

Nobody who is closely following the course of industrial controversy and negotiation in these days of continued strain and anxiety anticipates freedom from unrest for long at a time. The ever-changing demands of the war give rise to new situations every few weeks or months, and all of these new situations have to be negotiated with tact and sympathy in order that we may avoid the ugly rocks. It is useless to regard each new demand from Labour as an act of disloyalty, as a want of patriotism, or as treachery endangering our fighters in the field. Of course, there are, as always, even now, most unworthy elements at work which seem to aim at causing disaffection and in that way endangering the Allied cause, but, on the whole, we believe that their influence is not extensive. Indeed, considering everything, and observing the worse conditions obtaining in other countries, we have reason to be thankful that things have gone on as satisfactorily as they have during the past two or three years. What are needed above all, in these very irritating days, are coolness, calmness, and composure; if we have not these qualities we cannot expect to keep our heads and deal reasonably with difficulties which, we suppose, are more or less inevitable under the unparalleled circumstances of the times. Those who have been responsible for simultaneously maintaining the supply of men for the Forces, and maintaining or increasing the output of munitions, have had to deal with a host of problems, some of them very delicate in character, and possibly, when their wishes have inclined them in one direction, they have felt it to be more judicious to take another course because the main interests of the Allies were at stake. Step by step, as the situation has altered, has Labour been drawn from industry, and latterly workers on munitions have been called upon to take up the less remunerative, but more immediately necessary, duty of training for military service. The Trade Card system, introduced at one critical period to tide over an emergency, answered for a time, but its own inherent defects were soon revealed, for they caused disaffection between the men themselves. And now, in connection with the call for the half-million men that must be with the Colours by July in order to maintain our fighting forces against the wastage that the attacks on the Hindenburg line have necessarily brought, the Trade Card system has had to be abolished and other measures introduced for protecting the really indispensable worker in the factory. The past ten days have not unnaturally been an anxious period in this respect, but we trust that, by the aid of British good sense and general determination to defeat the enemy speedily, the new arrangements will be found to work smoothly.

Last Saturday night the Amalgamated Society of Engineers announced that its delegates had reached agreements with the Government, and that arrangements had been come to in connection with the schedule of occupations providing adequate protection for skilled men and apprentices. As a result, there has been no stoppage of work. In addition, the strike of engineers in South Lancashire, which was due to difficulties arising out of the dilution of private commercial work at a Castleton factory with female labour, and out of the question of the recognition of the engineering Trade Union, has also been settled. Whatever the terms of settlement in these cases, we suppose we must be thankful that the anxious period has again been successfully negotiated, so that we may get on with the war, recruiting the needed young men, and continuing the output of *matériel*. The engineering workers are essential to the conduct of the war, and, of course, they know it. A hundred times has it been stated by our leaders that the work being done in the engineering workshops is vital. Sir Edward Carson's message to the London Association of Foremen Engineers last Saturday put the matter very forcefully. He showed once again how the dauntless gallantry of our sailors, soldiers, and merchant seamen was of no avail without the assistance of the shipyards and the engineering shops, and that the answer to the latest German barbarism lay in those yards and shops. His appeal to all to redouble their effort until victory is won was timely, and very necessary at such a juncture, however familiar it may have become. "Until Victory is won"! But what after? The present anxieties, stress, and strain will have passed away, and the causes for irritation may be changed, but all of these experiences through which we pass now tell us very plainly that we may anticipate when there is Peace between the nations, new anxieties which will call for the most careful negotiation. Indeed, were it not for the strain of war-time conditions, and all that they mean to all of us, being largely responsible for prevalent disaffection, we should feel disposed to despair of a happy issue ever being arrived at in such a matter as Industrial Peace negotiations. The new spirit of the Trenches, of which we hear and say so much, does not seem to have reached Home yet. Will it arrive when "the boys come Home"? We trust that it may, and in order to perpetuate it, if it does, we need to continue now all the useful schemes and negotiations that we can produce designed to prepare the way. We will hope and prepare for the best, whatever we may conscientiously fear.

ELECTRO-CULTURE AND CROP PRODUCTION: RESULTS DURING 1916.

In view of the more extended knowledge of the effect of overhead electrical discharge on plant growth, which careful investigation has rendered available during the last year or two, the results obtained experimentally at Lincluden Mains Farm, Dumfries, during 1916, are of particular interest;

Electrified Oat Crop, August 8th, 1916.

more especially is this so, in view of the excellent record of the previous year.

These 1916 results were recently described by Prof. V. H. Blackman and Mr. Ingvar Jorgensen in an article in the *Journal of the Board of Agriculture*, and the authors

Oat Crop on (Unelectrified) Control Area, August 8th, 1916.

acknowledge their indebtedness to Miss E. C. Dudgeon in the carrying out of the experiments.

The experimental crop, as in 1915, was oats; the soil of the field was a sandy loam, and the field (of 9 acres) had been in pasture without manure for the three previous years, having been grazed over.

One acre was chosen as the electrified area, and two half-acres as controls; one control was near, but measurement showed that it received only a slight discharge, while the other control was out of the track of the prevailing westerly winds, and at such a distance that even with north-west winds it received practically no discharge.

The difficulty of confining the discharge to the area to be electrified is much reduced by keeping the wires low, and an earthed screen of wire netting was found unnecessary, owing to the low position of the wires and the position and distance of the controls.

Clover-hay Crop on Unelectrified Ground.

The overhead discharge was applied by means of a series of 21 wires running parallel to the short sides of a rectangular area (88 yards × 55 yards), the wires being about 4½ yards apart, and supported at their ends about

Clover-hay Crop on Ground Electrified the year before.

7 ft. from the ground, though towards the end of the experiment they sagged down to 6 ft. at the centre.

The current supplied through the primary circuit was about the same as in previous years, *i.e.*, 3 amperes at 50 volts, but owing to the lower level of the wires (7 ft. as compared with 10 ft. in 1915 and 15 ft. in 1914),

and the closer arrangement of the wires (13½ ft., as against 15 ft. in 1915 and 20 ft. in 1914) the intensity of the discharge received by the crop was much increased.*

The crop was sown on March 27th, appeared above ground on April 13th, and the discharge started the next day; by May 16th the electrified plants were markedly deeper green in colour and taller, and later measurements of the average heights of plants were as follows:—

	Electrified.	Control 1.	Control 2.
June 18th	19 in.	14 in.	12 in.
June 25th	24 in.	19 in.	18 in.
July 3rd	32 in.	21 in.	20 in.

After the latter date it was not possible to obtain measurements without damaging the crops.

It was clear that the electrification extended some little distance from the trial area, for the height of the crop round the area was above the average, and gradually decreased with distance.

The discharge was continued until August 17th, being used only in the day time and discontinued during actual rain; the discharge time was 848 hours during the season.

It was generally agreed that the oats were the finest crop in the district; unfortunately, heavy rain storms towards the end of August caused damage to the crop, and loss of grain occurred before harvesting. The yields obtained were as follows:—

Grain.		Straw.	
Electrified, Area, 1 acre.	2,637 lb.	Quality 1, 1,942 lb. Quality 2, 695 lb.	4,924 lb.
Control (1), ½ acre.	840 lb.	Quality 1, 630 lb. Quality 2, 210 lb.	1,218 lb.
Control (2), ½ acre.	924 lb.	Quality 1, 714 lb. Quality 2, 210 lb.	1,401 lb.

The electrified area, as compared with the controlled areas, gave an increased yield of 873 lb. grain, or 49 per cent., and 2,305 lb. straw, or 88 per cent.

The farmer who works the land estimates the loss from climatic conditions at 420 lb.; if this is accepted, the grain increase works out at 73 per cent. In 1915, when the oats were subjected to a weaker discharge, a 30 per cent. increase occurred in grain, and a 58 per cent. increase in straw.

The authors refer to the difficulty of accurately estimating the financial results; but based on market prices in the district, the increased value of the crop works out at £6 7s. per acre.

The energy used, about 130 KW.-hours, if reckoned at 1d. per unit, works out at only 11s.

The cost of an installation on a large scale cannot be predicted at present, but the profit shown above would permit of a heavy expenditure on an installation.

The authors conclude by pointing out that a new and important aspect of the problem has been disclosed by the discovery that *the application of the discharge one year may increase the size of the crop the next year*—*i.e.*, there may be a marked after-effect. The difference between the crop of clover-hay produced in 1916 on ground previously electrified and that on the non-electrified area was very marked, and an increased weight of crop was obtained from the electrified area. Two views show the areas in question, with the *second* crop of clover on the hay stubble in September; the first crop was cut in July.

If in addition to an immediate increase of the treated crop a succeeding crop is benefited, it is obvious that the agricultural value of the application is very much enhanced.

Much, however, still remains to be investigated in connection with the electric discharge; the conditions under which the effect is produced—its relation to light and humidity; the most suitable strength of discharge has to be discovered, as the experiments suggest that with a greater intensity of discharge still bigger yields might be obtained. Manurial conditions and effect of soils have to be investigated, also electrical engineering problems. The question of the manner in which the electric discharge influences the growth of a crop is still quite unsolved.

* The intensity of the discharge received can be increased by (1) lowering the wires, (2) reducing the distance between the wires, and (3) reducing the thickness of the wires. No. 24 gauge silicium bronze wire was used.

HIGH-TENSION OVERHEAD TRANSMISSION LINES.

By G. V. TWISS, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Several recent large power schemes abroad embodying transmission lines of the highest voltages have been engineered from this country, and our share of such engineering is likely to increase. Moreover, in view of the necessity for conservation of the coal resources of this country, and the fact that we must hold our own in industry against countries possessing abundant and very cheap power—derived from water and transmitted by high-tension transmission lines—it is quite possible that we may yet have transmission lines working at 100 kilovolts or so in this country. The present movement in regard to the linking-up of power stations may, indeed, necessitate transmission lines at voltages much higher than those used at present; and there is still the possibility of developments such as the transmission of power in bulk at high voltages from coal areas, as foreshadowed by Dr. Ferranti in his presidential address to this Institution. Hence the subject of transmission lines at the highest pressures is of increasing concern to us.

Transmission lines abroad and in the British Dominions, including those engineered from this country, show marked differences from those at home, as is shown in fig. 1. The

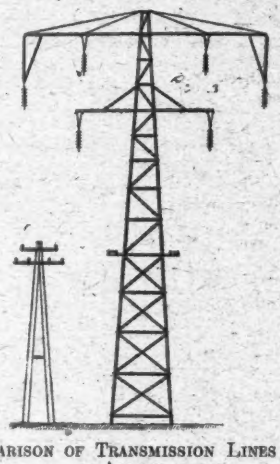

Fig. 1.—Comparison of Transmission Lines at Home and Abroad.

respective voltages, whilst accounting for the length of cross-arm, do not entirely account for the other differences. If, therefore, a 100-kilovolt line had to be built in this country, upon which practice would the design be based?

General Design of Transmission Lines.

Arrangement.—Conductors may be arranged in any of the ways shown in fig. 2. The diagrams show arrangements for double circuits, but for single circuits half of each diagram may be read.

The considerations which influence the choice of arrangement of conductors are as follows:—

(*a*) Electrical considerations.
(*b*) Mechanical considerations, such as:—
Possibility of wires swinging together.
Leverage on the cross-arms and poles.
Snow, either unevenly weighing down the conductors, or falling off and causing the conductors to foul one another or to come too close together.

From the electrical point of view, the A and B arrangements in fig. 2 are equally satisfactory. In any case, however, the maintenance of an equilateral triangle is not of the greatest importance, and on some of the largest modern transmission lines no attempt is made to obtain a triangular arrangement.

From the point of view of swinging together, C1 is the best, and B1, B2, and B3 come next, whilst as regards snow effects C1 is the worst, and the A arrangement is the best. The B arrangement, however, is equally good if the base of the triangle is tilted slightly as in B3.

It would appear, therefore, that the B arrangement with the base of the triangle slightly tilted is the best arrangement for double circuits, as it gives the shortest poles and the shortest cross-arms compatible with the absence of swinging together and snow effects, and incidentally maintains the triangular arrangement—which is desirable if nothing is lost thereby.

For pressures in the neighbourhood of 100 kilovolts this arrangement makes the top cross-arm somewhat long, as shown in fig. 1. The triangular members to which the insu-

lator is fastened at the extreme end of the cross-arm are, however, pivoted and form a sling* which, having no movement laterally, is free to swing in the line direction; hence, in the event of a conductor being broken on one side, the sling and the suspension insulator swing into the span, thereby materially reducing the tension.

For single-circuit construction the horizontal arrangement (C2 in fig. 2) appears to have advantages, as the pole is the shortest possible, and there is no possibility of the conductors fouling owing to snow. It requires, however, the maximum length of cross-arm, and triangular spacing as A or B is more frequently used in practice.

Clearance between Conductors.—The considerations affecting clearance between conductors are as follows:—

1. Mechanical, *i.e.*, the possibility of wires swinging into contact or dangerously close together.

2. Electrical considerations, which with the very high voltages must include the possibility of corona loss.

There seem to be no definite rules in regard to the clearance necessary for mechanical reasons, and the following dis-

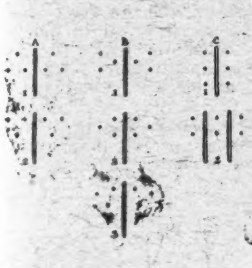

FIG. 2.—ARRANGEMENT OF CONDUCTORS.

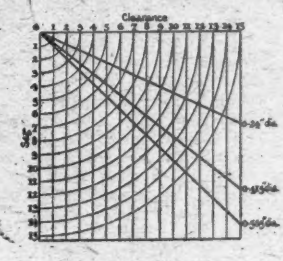

FIG. 3.—CURVE OF CLEARANCES.

cussion is given tentatively with a view to arriving at some basis.

Clearance with Horizontal Arrangement.—Wind may blow at any angle to the conductors, and with different velocities at different points in any span; hence a set of sagging conductors of small weight relatively to their wind area (for instance, very small wires, especially if of light material, such as aluminium) will tend to swing irregularly, *i.e.*, out of phase, and might touch or come dangerously close unless well spaced apart. Wires having a greater weight relatively to their wind area (*i.e.*, large wires, especially of heavy material such as copper) will have a more dead-beat action, and will tend to swing more synchronously, and consequently need not be spaced so far apart to obtain the same security against short circuits.

The curve of clearances shown in fig. 3 appears to give clearances which are comparable with the best practice.

Clearance with Vertical Arrangement.—Here the chief point to be taken into consideration is the possibility of the wires being unequally borne down by ice or snow, or of the wind lifting or depressing the wires unequally. The clearance will therefore bear a relationship to the span, and a clearance of 1 ft. per 100 ft. of span would appear to be a good rule.

Clearance with Triangular Arrangement.—If the base of the triangle is horizontal the clearance would be settled as above for horizontal clearance; if vertical, then the vertical clearance would settle it, and for all other cases the clearance could be adjusted accordingly.

In regard to (2) above, namely, electrical considerations, formulæ are already available.

The final clearance chosen for a given case would be whichever proves to be the greater, that indicated for electrical or for mechanical considerations; and in certain cases the necessary clearance between the conductors and the pole may necessitate a greater clearance between the conductors than that above obtained.

Clearance between Conductor and Cross-arms or Pole. Pin Insulators.—The clearance between a conductor and the cross-arm on a pin insulator is, of course, dependent upon the length of the pin. It is advisable that the distance from the conductor to the cross-arm should not be less than the distance from the conductor round the insulator sheds to the pin. Fig. 4 shows how the correct length of pin to provide this clearance may be determined.

Suspension Insulators.—As suspension insulators swing out of the vertical, the conductor may come close to the cross-arm and thereby reduce the clearance as measured from the conductor to the cross-arm over the insulator. In order to maintain this clearance the sling previously referred to has therefore been used. Fig. 5 shows a mast with these slings and the clearances thereby obtained. As a matter of fact, however, on the majority of transmission lines where suspension insulators have been adopted no such refinement has been used for the purpose of maintaining this clearance, and it is evidently considered that trouble from this source is so unlikely as not to justify special provision to prevent it. This theory is largely justified by the fact that an arc would always tend to strike in the path of the strongest electrostatic field, which would generally be that over the insulator.

* This is attributable to Mr. C. W. Kay, and is patented.

TENSION AND LOADING OF CONDUCTORS.

Comparison of Assumed Wind and Ice Loadings.—The Board of Trade Regulations assume the maximum conditions of loading to be a wind of 25 lb. per sq. ft. at a temperature of 22 deg. F. without snow or ice on the conductors; and a factor of safety of 5 is required on the conductors under these conditions.

Other countries make different assumptions and stipulate other factors of safety. The factor of safety of 3 is the one most favoured on the Continent, in fact, by most countries.

Economical Span Length.—In this country we find span lengths of the order of 150 ft., with a maximum of, perhaps, 300 ft., while abroad we find a usual span length of 500 ft., and in America and Canada as high as 700 ft. This is, of course, excluding abnormalities such as crossing valleys, rivers, and the like, which are common to all, and require special treatment. One can design to get equal safety with any reasonable length of span, and economy should be the only consideration.

A set of curves given in the paper for different sizes and different tensions and loadings of conductors provides a definite basis to work upon. From the curves it appears that:—

1. The larger the conductor the longer is the economical span, and *vice versa*.

2. The higher the tension of stringing, the longer is the economical span, and *vice versa*.

3. The larger the conductors the greater is the difference between the economical span lengths for U.S.A. and Great Britain conditions respectively (this is due to the ice loading on the U.S.A. conductors).

4. The higher the tension of stringing the less is the cost of the transmission line.

5. The greater the number of conductors the shorter is the economical span length.

6. The economical span length is never shorter than 250 ft. for the cases taken.

7. A wooden pole is impracticable for an ultimate strength of 24,000 lb. and over, whereas for ultimate strengths up to 6,000 lb. wooden poles have always the advantage over steel poles.

8. Wooden poles are the more economical up to the points of divergence shown on the curves.

Span lengths of 600 to 700 ft. for U.S.A. and Canadian conditions are, in certain cases, shown to be justified. On the other hand, spans of 150 ft. appear never to be justified on economic grounds, even with the low tensions of stringing used in this country.

Under Board of Trade requirements the cost of supports for spans of 150 ft. is shown to exceed the cost of supports for the economical span lengths by as much as £100 per mile. Similarly, for the economical span lengths the cost of supports under Board of Trade requirements is shown to exceed the cost of supports under Canadian and U.S.A. requirements by as much as £100 per mile.

Consequently, the cost of supports for spans of 150 ft. under Board of Trade requirements exceeds the cost of supports for the economical span lengths under U.S.A. requirements by as much as £200 per mile. This is on the cost of

FIG. 4.—METHOD OF DETERMINING LENGTH OF PIN.

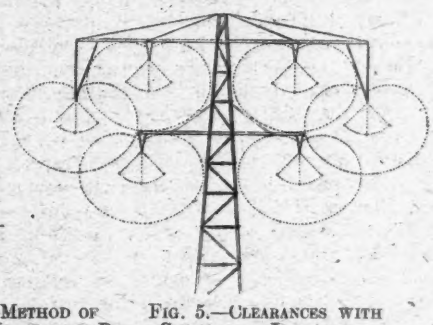

FIG. 5.—CLEARANCES WITH SUSPENSION INSULATORS.

supports delivered, but the cost of erection will be partly proportional to the number of poles, and consequently to the span lengths, so that the above-mentioned differences in cost when taken on such transmission lines completely erected will be greater.

From the foregoing it will be seen that it is expensive to obtain the factors of safety adopted in this country, especially on large conductors.

If any change were made, we could do with a higher factor of safety than that required by the Board of Trade Regulations for the smaller conductors, and a lower one for the larger.

EARTH AND LIGHTNING WIRES.

The use of a wire or wires to maintain a uniform earth potential throughout the line is desirable. Atmospheric disturbances may manifest themselves in the transmission line either as a direct lightning stroke or as an induced charge, in either case setting up a surge in the wires. Earth wires will never completely protect the line, and consequently the

insulators may still be called upon to withstand surges due to lightning; nevertheless, they provide a considerable amount of protection.

On transmission lines with the design of which the author has been concerned, earth wires have usually been adopted as lightning shields, and in common with most transmission lines they have always been of galvanised steel. The use of steel for these wires, particularly when placed above the conductors, has been deprecated on the theory that owing to the shorter life of steel compared with, say, copper, such wires may break and, by fouling the conductors, interfere with the supply. The shorter life of steel earth wires may be made still shorter by crystallisation. Steel is much cheaper than copper or bronze, and before abandoning it in favour of more expensive metals its life might at least be made a maximum by fixing the wire with the same regard to crystallisation as in the case of any other wire. A flexible clamp for this purpose is described later.

Loads at Terminals, Angles, and Intermediate Positions.

The poles upon which a transmission line terminates must deal with the maximum load due to the tension in the wires under the severest conditions. Such load is, however, in the longitudinal direction, and the maximum load in the transverse direction is only that due to the wind on the wires under the worst conditions, which is generally very much less than in the longitudinal direction.

With wood poles the terminal pole is often designed for the transverse load and stayed in the longitudinal direction, this method dealing exactly with the stresses. Lattice-steel poles used as terminal poles are generally designed to carry the maximum load in the longitudinal direction without staying, and are almost invariably made of equal strength in both line and transverse directions—in other words, there is a waste of strength in the transverse direction.

A transmission line generally deviates from the straight at various points, thus necessitating poles to deal with these angles. The load on these poles will, of course, be the resultant of the maximum longitudinal loads due to the tension of the wires. The wind cannot be blowing in a direction normal to the wires in both the spans adjacent to the angle at the same time. Hence, when calculating the resultant angle load it would appear that the longitudinal stress in the two adjacent spans should be taken as the maximum stress that can occur in each adjacent span simultaneously.

At all points of the line other than terminals and angles, the stresses in the longitudinal direction are balanced, or very nearly so, excepting when a wire breaks. It is therefore unnecessary to have poles capable of dealing with the maximum longitudinal loads—hence the use of a third class of pole, generally known as intermediate poles, capable of dealing with the transverse load due to wind on the wires. There is, however, a considerable divergence in practice as to the strength of such poles in the longitudinal direction.

If pin insulators are used, the means of attachment to the insulators will generally permit of the conductors slipping; and if suspension insulators are used, then the insulator string can swing out into the span, so that in the event of a break in either case the full tension in the conductor will not be transmitted to the support. Moreover, almost any pole will deflect to some extent, which will further reduce the stress. In fact, the remaining load would not be much more than, say, equal to the transverse load in the conductor.

If provision be made for the breaking of one wire out of three, this would indicate that the intermediate poles should have a strength in the longitudinal direction of one-third that in the transverse direction. Thus, in the remote event of all wires breaking, the load would still be within the strength of the poles by virtue of their factor of safety plus their ability to deflect. This is about the strength of the wooden A-pole upon which excellent results have been obtained, and, in the author's opinion, it provides a good basis of design for all intermediate poles.

(To be concluded.)

Discussion in London.

Mr. A. P. Trotter, in opening the discussion, said that after the war important developments in overhead transmission were probable, both at home and abroad. He thought that the author's comparative diagram of transmission structures at home and abroad was scarcely fair, as the large tower construction was dictated by considerations not applicable here; there was no particular advantage in the equilateral triangle spacing unless it was wanted, and arrangements of wires in a vertical plane were open to objection if the upper wires sagged too much from any cause. The factors of safety as between this country and abroad were as 5 to 2, and he thought this was probably the ratio of the class of work in the two cases. As regarded the Board of Trade regulations, in some cases a lower wind pressure had been admitted; it was distinctly stated that no allowance was made for snow or ice; the regulations were dictated by the special conditions obtaining in this country, and there was no limit to H.T. spans mentioned, while the 200-ft. limit for L.T. spans could be exceeded if that course were justified. He found that 120 ft. was a standard span for Canadian L.T. wires, and in this country the standard was often 240 ft. for our pressures. There was no limit, however, and in one case a span of 1,426 ft. was in use. It did not necessarily result that the long span was the cheapest constructionally.

Mr. Alfred Dickinson deprecated the suggestion of the previous speaker that transmission work abroad, in the Colonies, was less efficiently carried out than at home. He complained that the Board of Trade regulations were too inflexible, and it should be understood and stated that they were to be modified on occasion. It was not possible to lay down any hard and fast rule for factor of safety, and design must be dictated by the conditions to be met.

Sir Wm. Slingo said that heavy Post Office spans, with 40 to 60 wires, reached 180 ft. in length to-day, and shorter spans were rarely used, while 10 or 20 years ago spans of up to 300 ft. were used. In the recent gales over £300,000 worth of damage had been done to Post Office wires, but not a single wire of 600 lb. weight fell through snow or ice. Where wires of over 400 lb. weight fell, it was always due to the structure failing. There had been many cases where the accumulation of snow and ice was in the form of a flat horizontal band, which did not offer much wind resistance; it was also noted that the size of wire did not affect the accumulation of snow, and 400-lb. wire or heavier would stand almost anything.

Mr. A. Jacob said he quite appreciated the gradual growth of Board of Trade practice, but, on the other hand, American practice could not be ignored, and modern examples compared well as regarded breakdown with lines in this country. Countries dependent on hydro-electric power used overhead transmission lines to a far greater extent than here, and were dependent on such lines. No doubt ultimately long-distance transmissions would be adopted here. As the cost increased rapidly with higher factors of safety, he asked why in worse conditions abroad was it possible to employ a factor of safety of 3, while we required one of 5. He thought it was as much the business of the Institution as of the Board of Trade to frame the required regulations. The author had omitted all reference to aluminium; the latest development was the use of steel-core aluminium cables, which got over the trouble of excessive sag. As regarded the possible redrafting of the regulations, he drew attention to the work of Mr. Evan Parry, for the New Zealand Government schemes, and suggested that it was well worthy of study. He also drew attention to the aluminium-reinforced steel catenary employed for traction purposes by the Canadian Northern Railway at Toronto.

Mr. J. S. Highfield agreed with Mr. Trotter that it was well to err on the side of security, which he thought would become increasingly important. The cost would necessarily be higher, but the annual charges were always less, and he thought in the end the cost was no greater. The arrangement of wires in a vertical plane resulted in short cross-arms of similar length, and was satisfactory; if tubular poles were employed, the insides had to be painted to prevent corrosion, and the Cornwall Power Co.'s engineers had introduced a method of pumping the pole full of paint and letting it run out again. Long spans decreased possible trouble with landowners, and excessive testing of material was a mistake; it was better to trust in good material than to indulge in excessive testing.

Mr. Richards asked what temperature was taken by the author in his curves of sag; the whole question turned on this temperature. He thought Mr. Welbourn had taken 60 deg. F. In connection with later curves, he noticed that the author took a temperature of 132 deg. F., and asked why; he (the speaker) usually took 122 deg. F. It was necessary to assume something to calculate the length of pole. The author's curves did not take into account maintenance and life; it was well known that in this country steel did not last as long as wood for poles.

Mr. J. C. Wigham said the enormous tower shown as used abroad, for comparison with poles used here, did not seem to be justified by the data in the curves which appeared in the paper. It was not appreciated that the factor of safety must be higher with small wires; that was why the Post Office wires came down and the power wires did not.

Mr. W. M. Mordey asked for some definite information as to the comparative adherence of snow to copper and aluminium wires, and Mr. Jacob mentioned that the latter metal had a greasy oxide skin, and snow did not adhere to it to the same extent as to copper.

The President (Mr. C. P. Sparks) remarked that the last two papers had been brought forward in view of the importance which the Council attached to electric supply developments in this country. Some 30 years ago he (the President) had assisted Dr. Ferranti in the Bond Street installation, where they were forced to go overhead because they could not go underground, and it was found that the wires were safer uninsulated. Dr. Ferranti was intending to use 10,000 volts, but this was stopped by the 42 years' franchise coming in, which made it possible to use underground cables, otherwise they might have had overhead wires through London to-day. He then referred to the electrical installation of the Powell-Duffryn Co., which turned out some 75 million units a year, and used a 30,000-volt, 3-phase overhead transmission on the Merz-Hunter split-phase system. The average pole spacing was 350 ft., and the maximum spacing 750 ft.; the Kay type of steel pole was employed, with screens over railway, telegraph, road, or other power line crossings. The ends of the line were connected through 30,000-volt paper-

insulated cable, and no lightning arresters were used, the transformers being specially designed for the work.

The AUTHOR, in replying, said that high towers were employed because of the great span lengths. Despite the higher factor of safety adopted in this country, he could not agree that American and foreign transmission work was much less reliable; the Ontario Hydro-Electric Commission were satisfied with a lower factor of safety than usually adopted in American practice. The Board of Trade regulations did not result in an equal factor of safety with large and small wires. Many people were prejudiced against long spans under the mistaken impression that this lowered the factor of safety. He agreed with previous speakers on the evil of over-testing materials, and pointed out that under some conditions adequate insulation was almost impossible.

Mr. E. S. BYNG, in a written communication, drew attention to the latest development in reinforced concrete poles. In the case of wood poles, the cost of timber was going up by leaps and bounds, and in view of the rapid depletion of the forests, particularly on account of the abnormal demands during the past two and a half years, it was exceedingly doubtful whether stout wooden poles above 45 ft. would be obtainable after the war at anything like a commercial figure. The weight of concrete had hitherto practically prohibited this system from being utilised more generally for overhead transmission routes. In the latest development of ferro-concrete poles there were at least two or three manufacturers in this country who had adopted a hollow form of pole. These were of various cross-sections, some being square, some round, and others triangular, but in each case the object was the same, namely, to leave out the concrete where it was not required in the structure. The weight of concrete as compared with a solid pole up to about 45 ft. was thereby reduced to approximately one-third, and in poles of greater height this reduction would be even more. Some three or four weeks ago he had an opportunity of inspecting some ferro-concrete poles at Fulham which had been erected in 1910. They had not depreciated in any way, and, in fact, appeared to have improved through age. The poles in question were of hollow construction, 45 ft. in height, 16 in. square at base, tapering to 8 in. square at the top. A similar pole had been tested to destruction, and withstood a horizontal pull at the top of 90 cwt. before collapsing. One of the chief points about these ferro-concrete poles was the density and uniformity of the concrete. This was obtained by a special method of manufacture, consisting of an oscillatory-vibratory motion applied to the moulds whilst the poles were being manufactured, but before the "initial set" occurred. The patentees of this system contended that the concrete was perfectly homogeneous and impervious to moisture, and the pole after erection was practically indestructible. A further advantage claimed for hollow poles was that the design and construction allowed for any number of brackets or arms to be attached after erection. There would appear to be no difficulty in now obtaining poles to any height required for power transmission, as one firm (The British Improved Construction Co.) were preparing designs for wireless telegraph masts upwards of 700 ft. high for use after the war. Over 3,000 concrete telegraph poles had been recently erected in New Zealand, and had proved a great success, although one objection to their extended use was the question of transport. This difficulty had been overcome to some extent by the reinforcement being designed so that it could be put together and the structure made on site. The amount of steel reinforcement was approximately only one-third of the weight of steel used in an equivalent pole of all-steel construction, therefore, the weight of material (steel and cement) to be transported to convenient places for manufacture at intervals along the route would be considerably less than that of an all-steel pole (either tubular or lattice-work). A suitable aggregate for the concrete could generally be found in the immediate vicinity, and as this represented by far the greater proportion of the material required the freightage was thereby reduced to a minimum. In these circumstances the initial cost of ferro-concrete poles now compared favourably with that of any other type of construction, although this would not be of first importance if the annual charges were equated when working out the economics of the alternative proposals. In the case of the former, the maintenance and depreciation charges would be practically nil, but in either wood, tubular or lattice-work poles these were quite an appreciable item, particularly in the case of the latter, where the framework had to be painted at frequent intervals in order to prevent corrosion, which would otherwise quickly occur.

Mr. G. V. TWISS's paper was read and discussed at a meeting of the BIRMINGHAM LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS on April 25th, 1917.

Dr. KAPP said it was very satisfactory to find from the paper that English engineers had been so successful in extra-high-tension transmission work, which subject had up to the present been generally considered to be the special province of American engineers. He thought the author's allusion to the so-called "cheap water power" required qualification; as far as the cost of energy was influenced by capital outlay, water power was by no means cheap. The average of Italian hydro-electric works was about £30 per KW. The new electricity works at Walsall cost a little under £8 per KW. Whether the cost of energy was actually less in a hydraulic works than in a steam works depended on the load factor and the utilisation of the by-products from the coal. If the recommendations recently brought before the Institution by Messrs. Paton and Cramp were carried out, the cost of energy produced in a thermic works would under all the circumstances be less than that produced by water power, and this country could compete with any country where there was abundant water power, so that the author's paper would be found of great importance in the future development of home industries. In discussing the potential gradients in a string of insulators the author alluded to the effect of series and shunt capacity; it was interesting to note that the influence of shunt capacity had also been found to constitute a difficulty in the so-called Wurtz lightning arrester. These appliances could not be used for very high voltages because the potential gradient between the first few cylinders close to the line was extremely steep, and the addition of more cylinders at the earth end of the series did not materially flatten it. This was due to the shunt capacity. An Italian engineer, Mr. Moligniano, had overcome this difficulty by artificially increasing the series capacity between the cylinders so as almost completely to swamp the shunt capacity. By this means he obtained an almost straight-line potential gradient, with the result that the Wurtz arrester could be used on lines of very high voltage. The author advocated the arrangement of wires shown in fig. 2, B3, for duplicated three-phase lines because no wires were in a vertical line, presumably in order that in the event of an upper wire breaking it should fall clear of all the others; a wire broke generally under wind pressure and then, it seemed to him, the broken end would be blown sidewise and would foul other wires whatever might be the geometrical disposition. Hence, an arrangement which would be electrically preferable might be adopted, such as the hexagonal disposition so frequently used in Switzerland. It had the advantage of shorter cross-arms and less inductance. With the very high voltage for which the author's lines were designed the reduction of inductance was not of much importance, but with moderate voltages, this reduction, combined with the increase of capacity, had a beneficent effect on the power factor of the line.

Mr. A. GOLDIE ENGHOLM said that it was very important that the cost of maintenance for overhead transmission poles should be kept as low as possible. He had frequently found that Sherardising the iron fittings was better than galvanising, as very often the metal was eaten away underneath the galvanising, leaving only the outer skin, so that it was difficult by casual observation to detect such action.

Dr. C. C. GARRARD said the subject would be of very greatly increased importance in this country in the near future. It had been imagined by some people that transmission lines at very high voltages were only necessary or desirable in connection with water powers; with a rational use of coal, however, it was possible that we could produce electricity at a total works cost (excluding distribution costs) of £2 per KW.-year with a load factor of 60 per cent. This approached the best results attained by water powers. Under these conditions extensive overhead transmission lines at high voltages would be very numerous. It followed from this that it was very desirable that the standardisation of British overhead equipment should be taken in hand by the Institution and the Engineering Standards Committee, in order that while maintaining the British reputation for high quality in this branch of engineering, as in others, the development of the industry should not be hindered by the survival of obsolete official regulations. With regard to the testing of line insulators, Dr. Garrard directed attention to the method recently worked out in the United States by which the actual resistance of H.T. insulators was measured. By this means insulators having a slight degree of porosity, which would break down after several years' service, were eliminated before being put into use.

NATIONAL INSURANCE ACTS. 1911—1915.

AN application has been made to the Umpire for his decision as to liability in respect of platelayers employed in establishments carrying on any insured trade, involving reconsideration of decision 1,419.

Representations may be made to the Registrar, Office of the Umpire, 47, Victoria Street, London, S.W., on or before May 10th, 1917. The decision will be given on or after May 14th.

The following decisions have been given:—

Contributions are payable in respect of:

2,183X. Workmen engaged in the manufacture of gas-testing apparatus.

2,185X. Stablemen or other workmen employed in an establishment carrying on any trade insured under the National Insurance (Part II) Act, 1916, and engaged in tending horses which are used mainly on the premises of the establishment.

2,186X. Workmen employed in the manufacture of electrical appliances for railway signalling and for electric control of railway signalling installation.

2,187X. Workmen employed in the repair of coke oven bye-product plant.

2,188X. Workmen engaged in making incandescent oil lamps.

2,189X. Workmen engaged in adapting gas and candle fittings for electric light.

2,190X. Workmen engaged in making band saws and band knives.

2,193X. Workmen engaged in making (1) steering indicators, (2) fire-control apparatus for large guns, and (3) stoke-hole indicators and danger signals.

2,194X. Workmen engaged in drilling, filing, and riveting small iron castings such as caster horns, wardrobe hooks, &c.

2,197X. Workmen engaged wholly or mainly in the work of making metal, leather or rubber cycle and motor accessories.

2,202X. Workmen employed in the manufacture of metal barrels, drums, and tanks which are not intended to form part of the structure of buildings, ships, or vehicles.

2,217X. Workmen engaged in making and repairing steel barrows.

2,218X. Workmen employed in the manufacture of taximeters.

2,220X. Workmen engaged in the manufacture of brake blocks for cycles from vulcanised fibre, if intended for use in war.

2,221X. Workmen engaged in the installation in buildings or ships of accumulators for use in connection with electrical machinery.

2,222X. Metal workers engaged in the manufacture of kinematograph apparatus.

Contributions are not payable in respect of:

2,204. Workmen (other than those included under decision A.2,084X) (*Board of Trade Journal* of December 7th, 1916) engaged in the manufacture of asphalte and bitumen at works.

2,205. Workmen employed by a wireless telegraph company and engaged (1) in superintending and assisting in superintending the erection and maintenance of stations, and not employed wholly or mainly by way of manual labour, and (2) as works manager and assistant and foreman.

2,207. Workmen employed in the repair of coke oven plant (other than buildings, machinery, or bye-product plant).

2,208. Workmen employed by an electric supply company, and engaged in cleaning electric arc and incandescent lamps.

2,212. Workmen employed by gas companies, and engaged in the repair of gas retorts and retort settings.

2,213. Persons engaged in the manufacture of emery wheels which are not made in a mechanical engineering establishment solely for use in that establishment, and which are not for use in the manufacture of munitions of war.

WAR ITEMS.

Exports to China.—The "London Gazette" for May 8th contains further names of persons in Siam to whom exports may be consigned.

An American Searchlight Corps.—Forty-eight of the students at the Bliss Electrical School in Washington, U.S.A., have been formed into a searchlight unit under the Engineer Corps of the U.S. Army. The Corps, located in Washington, has recently been equipped with nine motor vehicles, four of which are fitted with 36-in. searchlights, four are travelling electricity generating plants to furnish the current for the projectors, while one is a supply vehicle.

Information Concerning Traders in Neutral Countries.—It is announced that information is being collected by the Foreign Trade Department of the Foreign Office from His Majesty's Consular officers abroad relating to firms in neutral countries with whom British houses could trade in place of firms of enemy origin or association which have been placed on the statutory list. The reports from His Majesty's Consular officers will give the names of firms desirous of trading with the United Kingdom, with references, bankers, commercial reputation, general nature of business, method of transport, principal goods immediately required, and whether the firm trades on own account or on commission basis. The following bodies have agreed to disseminate the information:—

The Association of Chambers of Commerce of the United Kingdom, Parliament Mansions, Orchard Street, S.W. 1, and its associated Chambers of Commerce.

The London Chamber of Commerce, 1, 2, and 3, Oxford Court, Cannon Street, E.C. 4.

The Federation of British Industries, 39, St. James's Street, S.W. 1.

Certain approved trade associations and federations not associate members of any of the above organisations.

Firms who are members of the associations enumerated above should apply for the information through one of these channels. The Foreign Trade Department reserves the right to refuse the information, in consultation with the Board of Trade, to any firm not British in character or dealing largely in articles competing with British manufactures. His Majesty's Consular officers have also been instructed to send duplicates of their reports to the Board of Trade, and the information will therefore also be available at the office of the Department of Commercial Intelligence of the Board of Trade, 73, Basinghall Street, E.C. 2.

Exemption Applications.—At Blackpool, the Military Representative asked for the review of exemptions given to 10 employés at the Corporation electricity works, and the Mayor said the borough electrical engineer would have to make out a strong case for men between the ages of 31 and 36. Mr. Furness said he was not representing the men, but the service. The works had to run 24 hours a day, 365 days a year. The certificates of two switchboard attendants, one 28 and the other 31, were cancelled (not to be called up until substitutes were found), and the others were allowed temporary exemption to June 30th. The certificates of two electrical fitters on the tramways were also cancelled, a month being allowed.

Cambs. Tribunal refused exemption to H. J. Diver (41), electrician at Milton Hall, Milton, appealed for by Mr. W. B. Redfern.

At Sevenoaks, the Electricity Co. appealed for P. H. Topping (27, Class B 3), engineer; J. J. Wickenden (31, B 2), cable jointer; and J. A. Shaw (30, Class A), engine fitter. The manager stated that without the men they could not continue the work. Mr. Topping was refused exemption, and the others were given three months each.

Hastings Tribunal has refused exemption to Mr. W. P. Gower (34), electrician, in Class B 1, who stated that he was voluntarily assisting in hospital radiographic work, and had enrolled for National Service.

Weybridge Tribunal has granted conditional exemption to G. Whittle (40), second fireman, appealed for by the Urban Electric Supply Co., Ltd.

Brighton Tribunal, on April 27th, reviewed the cases of 38 men engaged on the Corporation tramways, those concerned being a traffic superintendent (39, Class B 1), three traffic inspectors, 26 motormen, seven skilled mechanics, and a night foreman. The exemption certificates were withdrawn, the Class A and B 1 men were each given three months, and the others six months. A similar decision was arrived at in the cases of eight men engaged at the Corporation dust destructor.

Nine men engaged in the Corporation electricity works were appealed for at Brighton. Two were given a final month, provided they are classed up to B 2, and the others were each allowed three months' open exemption.

At Aldershot, a renewed appeal was made by Mr. J. J. Vertue (37), electrical engineer and contractor, who stated that he had a large number of electric motors to keep in order, these being used by firms for industrial purposes. He also maintained fire alarms, and the electric light and bells at various public institutions. His partner had been taken over for Government work in connection with work on the high-tension wires. A final month was granted.

Southend-on-Sea Tribunal has refused exemption, with 14 days' grace, to seven tram drivers appealed for by the Corporation. Six are in Class A, and the other in B 1.

West Kent Appeal Court has refused exemption to W. H. Brown (36), and E. Wicks (27), electricians, appealed for by Messrs. Oswald Jones & Co., electrical engineers, of Maidstone. Both are passed for general service.

Messrs. Hill, Upton & Co., electrical engineers, Oxford, appealed to the County Tribunal for W. G. Payne (29), electrician. It was stated that 90 per cent. of the firm's business consisted of direct war work, and that Payne was engaged on work of national importance. At present he was engaged on installation work at an aerodrome, and did no private work. Only four out of the pre-war staff of 30 remained, and women had been tried with success. The appeal was refused.

At Chipping Norton, the Electric Light Co. appealed for the retention of Mr. W. H. Hellyar, manager of the undertaking. He was temporarily exempted for two months for a substitute to be obtained, there to be no further appeal without leave.

RECENT INVESTIGATIONS OF TRACTIVE RESISTANCES TO MOTOR TRUCKS ON ROADS AND PAVEMENTS.

An experimental investigation was carried on in the research division of the electrical engineering department, at the Massachusetts Institute of Technology, during the year 1915, under a fund contributed for researches on motor trucks, for the purpose of determining the tractive resistance of a motor delivery wagon with four wheels and solid rubber tires on various level urban roads and pavements.

Our contemporary *Science*, from whose pages we reprint this article, mentions that the complete report on this research was published in the *Proceedings* of the American Institute of Electrical Engineers, June, 1916.

By "tractive resistance" is meant the horizontal force necessary to apply to the truck in order to keep it at a constant speed in still air after deducting axle frictions and internal-mechanism losses. It is, therefore, the reactive force offered by the truck, assumed internally frictionless, in overcoming the road, tire and still-air resistances on a level surface. It may be expressed either in pounds weight per short ton of total moving mass, or in kilogrammes per metric ton, or in per cent. equivalent grade. Thus a 1 per cent. equivalent grade tractive resistance means that a car without axle friction or other internal mechanism losses would require to be pulled on a level road at a constant stated speed by a force of 20 lb. per short ton of 2,000 lb. in order to overcome the resistance of the tires, road-bed, and still-air displacement. This force would obviously serve to propel the same vehicle up a 1 per cent. grade in the absence of tire, road-bed, still-air, and internal frictions. At a given speed, therefore, this tractive resistance depends upon the wheel, the tire, and the road, and also on the air-displacement resistance of the truck.

The truck tested was a 1,000-lb. (450-kg.) electrically-propelled delivery wagon equipped with single solid rubber tires, one on each of the four wheels—the tire rating being 36 in. by 2½ in. (914 mm. by 63.5 mm.). The tests were made by running the car at, as nearly as possible, constant measured speed, in alternate directions, over selected lengths of standard roads in and near Boston. From the observed storage-battery outputs during these runs, the corresponding tractive resistances were evaluated after correcting for all losses internal to the truck mechanism, wind losses, grade, and incidental accelerations. The internal losses of the truck mechanism from battery terminals to wheel spokes were determined from laboratory tests with the car raised from the ground on jacks, and by driving tested dynamos from the rear wheels.

The following is a summary of the results obtained as applying to urban roads with this truck between the speed limits of from 13 to 25 km. per hour (8 to 15.5 miles per hour):—

1. The over-all efficiency of the test-truck mechanism between battery terminals and rear-wheel treads reached a maximum value of about 78 per cent., under the most favourable conditions.

2. The mechanical efficiency of transmission from motor shaft to rear-wheel treads, for the truck tested, shaft-driven through a single-reduction worm gear, was found as high as 90 per cent.

3. Under the conditions of these tests, the tractive resistance on level roads, in the absence of wind, is composed of (*a*) displacement resistance, (*b*) impact resistance, and (*c*) air resistance.

By "displacement resistance" is meant that portion of the tractive resistance which depends on the lack of resilience of a smooth road surface and of the wheel-tire material; *i.e.*, on the energy losses due to inelastic displacement of tire and road-surface materials.

By "impact resistance" is meant that portion of the tractive resistance which depends on the lack of smoothness of the road surface, and which is due to the impacts given to the moving vehicle by the irregularities of the road.

By "air resistance" is meant that portion of the tractive resistance due to air pressure on the moving vehicle necessary to displace the air in the absence of wind.

4. The displacement resistance varied from 0.85 per cent. equivalent grade, for a hard smooth asphalt or bituminous concrete, to 1.6 per cent. for a very soft tar-macadam road, and was practically constant, for all speeds considered, on any given road.

5. The impact resistance increases with the velocity, with the total weight of vehicle, and with increasing road-surface roughness. In these tests, the impact resistance of good asphalt or bitulithic or other smooth pavement was practically negligible, and reached its highest values (about 1.5 per cent. equivalent grade at a speed of 20 km. per hr.—12.4 miles per hr.) on granite-block roads with sand-filled joints, and on badly worn macadam pavements. The rate of increase of impact resistance with speed was most marked on the roughest roads.

6. At the vehicle speed of 20 km. (12.4 miles) per hour, the air resistance for the vehicle tested, assumed to be dependent only on the speed, was roughly 0.11 per cent. equivalent grade, *i.e.*, from 4 per cent. of the highest to 12.5 per cent. of the lowest total tractive resistance.

7. The following urban pavements are enumerated in the order of their desirability for vehicle operation from the point of view of tractive resistance at 20 km. (12.4 miles) per hour, as found in this investigation: (1) asphalt, (2) wood block, (3) hard smooth macadam, (4) brick block, (5) granite block with cement-filled joints, (6) cinder, (7) gravel, (8) granite block with sand-filled joints.

8. The equivalent grade at 20 km. (12.4 miles) per hour of a badly worn city macadam road was found to be nearly three times as great as that of the best asphalt road tested. This means, at this speed, a consumption of energy at wheel treads of nearly three times as much on level poor macadam roads as on good level asphalt roads.

9. Increasing the gross weight of the vehicle by 12 per cent. through load was found to have no effect on tractive resistance within the observed speed limits for smooth roads in good condition; but on rough roads a distinct increase in tractive resistance with this extra weight was observed.

10. The presence of a layer of dust, say, 1 cm. thick, on a fair macadam road was found to increase the equivalent grade of tractive resistance, at a speed of 20 miles (12.4 km.) per hour, from 1.17 to 1.32 per cent.

11. A freshly tarred, and therefore very soft, tar-macadam road was found to have an increased tractive resistance equivalent grade, at substantially all tested speeds, of about 0.5 per cent. The tires in this case sank about 0.8 in. (2 cm.) into the road bed, the gross car weight being 2,140 kg. (4,718 lb.).

12. The total range of tractive resistance equivalent grade covered in the tests was from 0.93 per cent. on the best asphalt road, at lowest speed, to 2.7 per cent. on the worst macadam road, at nearly the highest speed.

13. The results indicate, as has already been pointed out by other observers, the importance of constructing and maintaining smooth, hard, and clean roads from the point of view of tractive resistance. Low tractive resistance means small gasoline consumption for gasoline trucks, and a reduced electricity expense or greater daily mileage with electric trucks.

14. Other problems which are of practical importance to vehicle designers and operators, and which require further investigation, are the following:—

(*a*) Tractive resistance on country roads.

(*b*) Tractive resistances to vehicles with different wheel tires.

(*c*) Tractive resistances of urban roads at low speeds from 0 to 10 miles per hour (16 km. per hour).

(*d*) Tractive resistances at speeds higher than 15 miles per hour (24 km. per hour).

(*e*) Tractive resistances for high-capacity trucks.

15. The results of the tests here reported have been found to be in substantial agreement with those obtained by other observers employing somewhat different methods; but the analysis of tractive resistance into its components here presented appears to be new, and is recommended for use in similar investigations or tests.

The authors of the report, Messrs. A. E. Kennelly and O. R. Schurig, express their indebtedness to Mr. Thomas A. Edison, and also to the Gould Storage Battery Co., for funds by which the research was made possible.

LEGAL.

North of Scotland Electric Light and Power Co., Ltd., *v.* North of Scotland Fish Guano Co., Ltd.

In the Court of Session, Edinburgh, Lord Cullen allowed proof some time ago in the action in which plaintiffs, of Montrose, sued the defendants, of Aberdeen, for £93 14s., said to be due and resting owing, and for £1,000 as damages for breach of contract. The pursuers stated that in April, 1913, they entered into an agreement with the defenders, who had a manufactory in Montrose, to erect certain plant for defenders in Montrose, and the defenders undertook to pay the pursuers £500 for electrical energy in addition to charges for hire of plant. In December, 1915, the defenders intimated that they were closing their Montrose works, and asked the pursuers to dismantle and take away the motors. The pursuers contended that the defenders had no power to terminate the contract in such a manner, and stated that, in order to carry out the contract with the defenders, they had found it necessary to increase their plant at a capital cost of £3,420. The defenders maintained that the difference between the parties fell to be decided by arbitration. They explained that the termination of the contract was occasioned and justified by the actions of the King's enemies and the existence of a state of war, in respect that the whole fishing trade of the North and East of Scotland and the import of raw material for the defenders' works and business at Montrose had been stopped. It was, therefore, impossible for them to carry on business there, and the contract had become impossible of performance. The action has now been taken out of Court by joint minute, having been settled by a payment to the pursuers of a sum in name of damages and expenses.

Laycock *v.* South London Electric Supply Corporation, Ltd.

Horace Scott Laycock made an application to the Lambeth Court to determine the nature and amount of security to be given by him to the defendants in respect of the supply of electrical energy to the premises known as Khaki Hall, Acre Lane, Brixton.

Mr. Laycock said that he was leaseholder of the Khaki Hall. On March 12th, 1915, he entered into an agreement with the company for the supply of electricity on special terms. It was agreed that his account should be paid weekly, and no security was asked for, as under that arrangement the company had power to cut off the supply if he failed to pay. On April 18th last the company wrote to him demanding a deposit of £20, on the ground of the difficulty of obtaining payment of his accounts. He replied that

the weekly payments had been regularly made, and refused to make a deposit of £20, seeing that he had made a claim of £39 against the company in respect of alleged overcharges. The yearly consumption amounted to about £250, and that had been regularly paid for. After he refused to make a deposit the company cut off the supply, and he had to deposit £20 under protest in order to get it restored.

Mr. Parsons (an official of the company): The company's case is summed up in the letter of April 18th :—"Owing to the difficulty which is always experienced in obtaining payment of your account." There are always two or three weeks owing. The company were only able to obtain payment of their accounts by threatening to cut off the supply, and Mr. Laycock was liable to be called up at short notice. Although the company did not ask for any deposit when the agreement was entered into, they were entitled to ask for one at any time they thought it necessary.

Mr. Laycock said it was nonsense to suggest that the company were only able to obtain their money by threatening to disconnect the supply.

Mr. Biron came to the conclusion that, in all the circumstances, £20 was not an unreasonable amount for the company to require as a deposit.—*Morning Advertiser.*

British Power, Traction, and Lighting Co., Ltd., *v.* Hodgson.

This protracted litigation was settled on an appeal by Mr. A. E. Hodgson from a judgment of Mr. Justice Peterson of November last, the hearing of which was concluded before the Master of the Rolls and Justices Bankes and Warrington on Tuesday last.

The order appealed from declared that Mr. Hodgson was liable to bring into Court a sum of £7,000 odd found due from him on taking an account ordered by a consent judgment in May, 1905, in an action brought against him in respect of dealings in 1901. In answer to the claim the defendant set up his bankruptcy and discharge, but the plaintiffs contended that the original action was based on fraud, and therefore bankruptcy was no answer.

The Master of the Rolls, in giving judgment, said the matter was so complicated as to be almost beyond endurance. That Mr. Hodgson had no right to the money for which the company sued, was beyond question ; but he failed to see that it had been established that it was agreed that the consent judgment should be a judgment for a debt incurred by fraud or fraudulent breach of trust. For that reason, Mr. Hodgson must succeed, and the appeal must be allowed in so far as the judgment of the Court below held the defendant outside the provisions of the Bankruptcy Act.

The other Lords Justices concurred, and the appeal was allowed accordingly.

REVIEWS.

Some Modern Methods of Ventilation. By R. Grierson, A.M.I.Mech.E. London: Constable & Co., Ltd. Price 8s. 6d. net.

The ventilation, like the heating, of buildings is a subject which until recent years has not received a fraction of the investigation that it undoubtedly merits. Heating and ventilation are two of the three fundamental factors which make or mar our personal comfort, and, unfortunately, are by no means easy to control; lighting is the third factor, but has been so exhaustively studied that it presents no great difficulties to the engineer who has provided himself with the proper qualifications, and as for the minor features of our indoor environment, such as furniture and decoration, the are comparatively elementary matters. Even in the case of public buildings of the most modern construction grave errors are frequently met with in respect of the arrangements made for heating and ventilation, errors, moreover, which it is almost impossible completely to rectify when the building is finished and occupied. Hence, we cordially welcome this book, based upon a wide experience, which should afford valuable assistance to architects and engineers responsible for the design of ventilating systems.

The author begins by pointing out the illusion under which we have laboured in past times with regard to the supposed deleterious effects of carbon dioxide, and lays stress on the fact proved by Dr. Leonard Hill and others that "*the physical effect upon the skin is the supremely important thing for us, not its chemical effect.*" He then gives data as to the quantity, &c., of air required in stated cases, together with the principles to be followed in designing a system of ventilation. He advocates the "balanced" system in which one fan pumps fresh air inwards and another removes the vitiated air, and shows how the apparatus and air ducts should be arranged, with the aid of numerous plans and half-tone illustrations. The design of air ducts and registers is adequately dealt with, various types of fans are discussed, apparatus for "conditioning" air as regards humidity and temperature are described, and methods of control are explained. The use and production of ozone forms the subject of a brief chapter, after which the instruments available for measuring the qualities of the air supply are described, and the tests to be made are discussed. For driving fans the electric motor is, of course, recommended, and information is given to assist the purchaser in selecting suitable apparatus; sample specifications are also provided. The last chapter briefly describes the use of wet air filters for cooling electrical machinery. We have no hesitation in commending this practical and instructive book to those who are concerned with the subject of ventilation.

Principles of Alternating Current Machinery. By Ralph R. Lawrence, Assoc. Prof. of Electrical Engineering of the Massachusetts Institute of Technology and Harvard University. London: Hill Publishing Co. Price 18s. 9d. net.

This is an excellent general text-book of the subject indicated by the title—indeed, the reviewer thinks it is, on the whole, the best book of the kind which has appeared for some years.

Too many of the text-books in general use are based on the types of machinery which were "modern" 10 years ago, or even more, and, although they have perhaps been "brought up-to-date" by the addition of sections dealing with turbine generators and commutator motors, the general plan is still the same as that which appeared to be the best to follow when the field to be covered was much more restricted than it is at the present time.

Although the author modestly disclaims the use of new methods in his treatment, and only professes to have collected material from existing sources, his work deserves recognation for the judgment used in the selection of material and in its excellent arrangement, which constantly displays a freshness and a breadth of view which makes the book highly instructive and helpful.

Prof. Lawrence has written a text-book on the principles of electrical machinery as it is at present developed. In doing so, he has kept constantly before him modern developments, modern problems, and modern points of view. Thus, even in the earliest chapters he has approached the subject with only modern types of machines in view, and with constant reference to the modern conditions which determine their output and performance.

A good example of how this method of treatment has profited by taking a wide view, instead of keeping to the older conventional methods, is his treatment of the subject of alternator armature reactions (Chapter IV). After a general explanation of the nature of armature reaction (or armature magnetomotive force), he proceeds to discuss the reaction for the case of an alternator with non-salient poles and a distributed winding. He is thus able to arrive at a result which is fairly simple and, at the same time, practically accurate. The consideration of the armature reaction in alternators having salient poles is next treated as a more complex example of the principles already explained.

The induction of voltage in the armature, taking into account the shape of the flux curve and the angle of embrace of the coils, is concisely and clearly explained. This is followed by a simple, but adequate, discussion of the effect of the spacing of the armature winding on the resultant voltage and wave-form.

After discussing the principles of armature reaction, the author deals with the calculation of the regulation of an alternator by the synchronous impedance, magnetomotive force, Potier, American Institute, and Blondell's two-reactance methods.

Methods of obtaining values for the leakage reactance from the short-circuit test and zero power-factor characteristic are followed by the determination of effective armature resistance.

Further chapters deal with the experimental determination of losses and heating tests, and are followed by a detailed calculation of the constants of a 1,000-K.V.A. machine from the constructional data.

Altogether 150 pages are devoted to the alternator, and it will be gathered that the most important principles of the machine receive very comprehensive treatment so far as they are concerned with construction, behaviour, and operation, as distinguished from actual details of design.

In completing our analysis of the contents of the book, it will be unnecessary to enter equally fully into the treatment of other types of machines, as the treatment is carried out with the same thoroughness and judgment.

Transformers are next dealt with. After a description of details of construction, the magnitude and wave-form of the magnetising current are dealt with, and the reason for the current rush on switching on is given, though the stresses set up in the insulation on opening or closing the circuit are not considered in detail. Vector equations and the "equivalent circuit" of the transformer are given. Here and elsewhere the notation employed does not distinguish between vectors and numerical values of the quantities expressed. This leads to absurdities such as (see p. 192)—

$$I_2 = I_2 (\cos \theta_2 - j \sin \theta_2),$$

and on page 305—

$$-A = A (\cos \theta - j \sin \theta),$$

and other similar expressions.

The synchronous motor is clearly treated by means of vectors, and the subject of the distribution of the load between parallel alternators as affected by various conditions, *e.g.*, the characteristics of the driving engines, is well ex-

plained. The main points characterising the synchronous converter are concisely given.

The section on polyphase induction motors contains a very full analytical treatment by means of vectors, and is well calculated to give an insight into the principles underlying their operation. The induction motor is regarded as a special form of transformer, which enables the vector equations to be obtained in a simple manner. Here again, however, the notation appears to be much less clear than is desirable, and a student might easily be led astray by using it; for instance, in obtaining power as the product of a current and voltage, seeing that it is never very clear where a symbol used for a current or voltage denotes a numerical value or a vector.

The single-phase induction motor is dealt with in rather general terms without any very satisfactory diagram of its operation, though the student should be enabled to form a fairly clear idea of the main principles from the treatment given.

The various forms of single-phase motors with a commutator are discussed in the last chapters. Here, again, a close analysis of the operation is not given, but the underlying principles of their working are clearly explained.

In conclusion, we can congratulate the author on the production of an excellent students' text-book, which is thoroughly sound and calculated to form a substantial general foundation of knowledge on which the student can develop a specialised study in any direction without feeling that he starts with only nebulous ideas lacking a definite basis. For students of electrical engineering in universities or technical colleges the work can be cordially commended.

The Calculation and Measurement of Inductance and Capacity. By W. H. Nottage. London: The Wireless Press, Ltd. Price 2s. 6d.

This is a useful summary, in a condensed and handy form, of rules and formulæ for the calculation of the inductances and capacities of the various conductors used in wireless telegraphy, followed by brief descriptions of the apparatus and methods of measurement employed in the determination of these quantities.

The book divides itself naturally into two sections, the first dealing with the formulæ for calculation, and the second with measurement.

The formulæ are derived from many sources, published papers, &c., and are generally clearly given in a form indicating the purpose and limitations of their application, while the necessary tables of constants are also appended. The origin of the formulæ is generally stated (an important and valuable feature), and incidental examples of their application to actual problems are also interpolated in a number of cases. Little or no attempt is made to give the method of derivation of the formulæ, and, indeed, any such attempt would have completely altered the character of the book and necessitated its conversion into a theoretical treatise instead of a collection of formulæ.

To give a general idea of the contents of this section, it will be sufficient to enumerate a few of the principal formulæ given.

The inductance of a straight cylindrical wire and of a thin tape is followed by values for parallel conductors. Then follows the inductance of a coil (Nagaska's formula), with developments for various forms of winding as given by Rosa, Butterworth, and others. Mutual inductance between conductors and coils is next introduced, including a simple graphical method by the author for the mutual inductance of two single-layer coils.

In dealing with the capacity of conductors of various forms, a similar procedure is adopted, and the consideration of plates and simple line conductors is followed by that of various forms of antennæ, while the influence of the earth and of masts and buildings is also included.

While the author rightly employs absolute electrostatic units in his formulæ dealing with capacity, he makes one or two slips where other units are referred to. Thus, on page 38 he boldly makes the statement that "the absolute unit on the electromagnetic system is the farad, and the practical unit the microfarad." Of course, the farad is 10^{-9} (or one thousand-millionth) of the absolute unit of capacity in the electromagnetic system. On the same page we read: "In calculating capacity, if all dimensions be in centimetres the capacity is given in electrostatic units or centimetres." While this is perfectly true of the formulæ which follow, it is somewhat misleading, seeing that the centimetre is the unit dimension applied to conductors of both electromagnetic and electrostatic systems, whereas it is the dimensions of the unit of quantity of electricity which is the real characteristic of the electrostatic system, and which determines the unit in which capacity will be given.

On page 55 there is a mistake in the equation for V, owing to the substitution of mmfds. (micro-micro-farads) for electrostatic units of capacity. Seeing that one mmfd. is equal to 0.9 electrostatic units, the error introduced is not large.

The second part of the book deals with methods of measurement, and the author has collected together a large number of alternative methods for measuring inductances and capacities, some of which are not well known to the ordinary worker. The chapter on the measurement of inductances gives the diagram of connections and the ratios when balance has been obtained for a great many "bridge" methods. The chapter on capacity measurement deals similarly with alternative methods of carrying out capacity tests, while another chapter describes the methods to be used where high-frequency currents are employed. The last chapter gives particulars of a number of special appliances used in measurement, such as standards of inductance and capacity, high-frequency generators, wave-filters, vibration galvanometers, secohmmeters, &c.

The summary of the methods and appliances used in measurement which occupies the last chapters of the book is likely to prove useful and handy for reference. Little attempt is made to discriminate between the various methods or to point out their relative advantages, defects or limits of accuracy. Also, no detailed instructions or cautions are given for carrying out the measurement. This would have entailed considerable extension of the scope of the work and would have changed its character from that of a concise summary to that of a text-book. We may perhaps hope that at some future time the author may carry out this more ambitious scheme.

On the whole, the diagrams are clear, though the curve on page 42 has been so much reduced that the figures indicating the scales have become quite illegible. Another minor criticism is the use in one part of the book of the symbol "ω" to denote the quantity $2\pi n$ which is later always expressed as "p."

As a compact volume of reference for those who are concerned with calculations or measurements of inductances and capacity this modest work can be cordially commended.

BUSINESS NOTES.

Russian Exhibition in London.—We have received some literature regarding the Russian Exhibition which is being held this month at the Grafton Galleries in Bond Street, W. The Exhibition has a Russian Commercial Bureau, under the care of Mr. R. A. Lenski, and a Russian Trade Section, where information can be obtained on matters affecting Russian commerce and industry. The Exhibition has the Royal patronage, and among the exhibits is a collection of Russian trade catalogues. The Russian Consul-General is daily in attendance, assisted by a staff of Russian commercial authorities. Mr. Lenski has issued a pamphlet on "The Russian Market, and How to Enter it."

Book Notices.—We have received a copy of No. 1 of "The Channel," a bi-monthly sixpenny "Clyde Shipbuilding, Engineering and Electrical Gazette," which is published at 131, Newark Street, Greenock. It contains a good deal of useful and interesting matter on such subjects as:—Lost Time in Shipyards, The Trend of Development in Marine Engineering, The Story of Petroleum, Electric Supply Costs (by Mr. F. H. Whysall), Proceedings of Societies, Technical Queries, and so on.

"*Journal* of the Institution of Electrical Engineers." Vol. LV. April, 1917. No. 265.—This issue contains the following papers:—Voltage Regulation of Rotary Converters, by Mr. G. A. Juhlin; Machine-Switching Telephone Gear, by Mr. F. R. McBerty; Determination of the Sequence of Phases from Wattmeter Readings, by Dr. G. Kapp; Chairman's Address to the Hong-Kong Local Centre; also the Report of the Council and the Statement of Accounts for the year.

We have received a copy of No. 1 of the "Windsor Works Magazine," a twopenny monthly publication issued by Messrs. G. D. Peters & Co., Ltd., of Windsor Works, Slough, manufacturers of rolling-stock supplies.

Bankruptcy Proceedings.—J. G. S. Cunnington and H. P. Allison (Laing, Wharton & Cunnington), electrical engineers and contractors, 7, Great Newport Street, London.—Supplemental dividend of 5¾d. in the £.

James Brockie, mechanical engineer, 41, London Road, Forest Hill.—Trustee released April 28th.

British X-ray Industry.—It is announced in the *Daily Telegraph* that a section of the British Electrical and Allied Manufacturers' Association has been formed enrolling British manufacturers of X-ray and electro-medical apparatus, with the object of improving the status and prospects of the industry by co-operation and research. Mr. Dunlop writes to our contemporary:—"Since 1914 great strides have been made by individual British manufacturers, and it is hoped that the enrolment of its members as a section of this association will further help to place and maintain this important industry in a position where it can supply not only the home trade but the whole of the Empire. British manufacturers have been at a serious disadvantage owing to lack of co-operation by which to meet the keen competition which existed in the world market. The section views most hopefully the future of the X-ray and electro-medical industry in this country, and earnestly invites the co-operation of medical men and hospitals with the object of supporting and strengthening the movement towards the exclusion of foreign-made apparatus."

Catalogues and Lists.—SCEANDO LAMP CO., LTD. 7, Blackfriars Street, Salford, Manchester.—Folder giving revised prices of "Sceando" half-watt and Axial lamps. The revision is due to increased cost of raw materials and wages.

MESSRS. T. W. BROADBENT. LTD., Victoria Electrical Works, East Parade, Huddersfield.—Leaflet No. 6, describing and giving weights, dimensions, and prices of their R type A.C. slip-ring induction motors. Copies will be sent on application.

MESSRS. FERRANTI, LTD., Central House, Kingsway, London, W.C. —List Pa. 550/E, containing a description, with illustrations, prices, weights, and code-words of their standard H.T. interlocked, iron-clad switch cubicles.

Liquidation.—KILOWATT PUBLISHING CO., LTD.—A meeting is called for June 7th, to hear an account of the winding up from the liquidators, Messrs. A. Webster & E. A. Burnie.

British De-Tinning Progress.—We are pleased to learn that the British De-Tinning Co.'s scheme for dealing with old tins and the like is making satisfactory progress, despite many obstacles, mainly occasioned by war conditions. Not only does the project conserve wealth, as represented by various valuable metals, but also it creates a new British industry in place of what was formerly a German monopoly, some forty or fifty thousand tons of waste metal having been annually exported in pre-war days. Some of the Departments of the Ministry of Munitions are now showing considerable interest in the scheme, and arrangements are being made for the British De-Tinning Co. to utilise waste metals from the front and other military sources.

The company has issued a booklet entitled "Capturing a German Monopoly," which contains full reports of the proceedings at a Conference held at the Caxton Hall, London, in December last, together with reprints from the Press and other interesting matter. There is also an introductory article which deals fully with all aspects of the subject. A copy of this work will be sent free to those interested. A Committee was appointed by the Conference to investigate the processes and report on the soundness of the proposals so far as they affect municipal authorities. A building for practical demonstrations has now been completed at Wandsworth, and we understand that the Committee will shortly be asked to visit this works.

A subsidiary company has been formed with offices in Glasgow, and buildings have been acquired which will shortly be in full operation. Its operations will be superintended by the parent company in London.

LIGHTING AND POWER NOTES.

Aberdeen.—With reference to the recent sanction for borrowing £40,000 for the electricity undertaking, this is for the provision of a 5,000-KW. turbine plant, new buildings, sub-station plant, cables, &c.

Australia.—The Flinders Council (Vic.) has decided to apply for an Order in Council authorising the installation of electric light and power at Sorrento.

The Melbourne City Council electricity undertaking proposes experimenting with Victorian brown coal for the production of power.

Application has been made by the Lockhart Municipality (N.S.W.) for power to generate and supply electricity.—*Tenders.*

The report of the working of the Footscray (Vic.) electric light undertaking for the year 1915-16 shows a gross profit amounting to £6,154, and a net profit of £4,173; since the inauguration of the scheme the net profit has been £9,683. Of this £1,000 had been placed to the credit of the general revenue of the city. In addition, the Lighting Committee's credit balance, averaging £3,500 a year, had been used in the city's general financial operations, thus reducing the usual overdraft.—*Melbourne Age.*

Baildon (Yorks.).—The Shipley Electricity Committee has recently been notified by the Baildon Council, in reply to its offer to supply electricity to Baildon, that it favours the terms offered by the Bradford Corporation, and has asked the latter to forward a draft agreement.

Bradford.—The severely restricted lighting during the past year has occasioned much complaint, but some satisfaction is derived from the fact that the past year's expenditure of the city has been £10,000 less than the estimates, chiefly due to reduced cost of public lighting.

Burnley.—WAGES.—The applications on behalf of the National Union of General Workers for an increase in the wages of electricity employés, bringing up the total advance to 12s. a week since the war, has been referred to a Sub-Committee. Similar applications are being made in other Lancashire towns.

Burton-on-Trent.—Subject to consent, an induced draught fan is to be fitted to increase the steaming capacity of three boilers. The cost of this is estimated at £400, and it is hoped it will meet the anticipated demand for electricity next winter.

Crewe.—YEAR'S WORKING.—The electricity department has sustained a loss of £1,173 on the year's working, owing to the great increase in the cost of fuel, wages, &c.

Continental.—NORWAY.—According to a report by the U.S. Consul-General at Washington, the Norwegian Government has recently been advised by the Committee of the Storthing not to allow foreigners or foreign companies to acquire waterfalls in Norway, except in special circumstances. The power contained in the Norwegian waterfalls has been estimated at from 6,000,000 to 10,000,000 H.P., and the development of these falls has been accomplished largely through the aid of foreign capital.

The acquisition of water power by foreigners in Norway is regulated by the Law of September 18th, 1909, by the terms of which only the Norwegian Government or Municipalities or Norwegian subjects were permitted to acquire waterfalls of more than 1,000 H.P. without Government sanction for each individual case. This Law was made more stringent by the Law of August 4th, 1911, which provided, *inter alia*, for a tax payable to the local authority and the State.

A Royal Commission, which has been at work for several years on a revision of concession legislation, has just submitted to the Storthing a new Bill. Under this Bill it will be more difficult for foreigners to invest capital in Norwegian industrial enterprises and other real property. It is also proposed that foreign subjects and companies shall not be allowed to acquire concessions except in special cases, as, for instance, when an industrial concern already in operation wishes to acquire or regulate a waterfall. Joint stock and other limited liability companies must in future have an entirely Norwegian board, with registered offices in Norway, and exclusively Norwegian capital, in order to obtain permission to acquire waterfalls.—*Board of Trade Journal.*

Darwen.—The loss on the year's working of the Corporation electricity undertaking has been £2,889; the Daylight Saving Bill is stated to have reduced the revenue by over £1,000.

Doncaster.—PRICE REVISION.—The Electricity Committee has recommended the T.C. to revise the scale of charges in works where motors aggregating 100 KW. and over are installed, in view of applications received from several big firms for supplies of current for power. A sliding scale is to be charged, according to the load factor, from 60 per cent. down to 25 per cent., the price at 25 per cent. to remain unchanged.

Halifax.—WAGES.—The Town Council, last week, adopted the recommendation of a Special Committee that the wages of all Corporation employés of 21 years of age, except those of the clerical staff and the tramways department, be increased as from April 1st, to bring them, including war bonus, to 8s. per week above the pre-war standard.

Hull.—The Electricity Committee last week considered the application of the employés of the Sculcoates Lane power station for increased wages. It was decided to refer the matter to the Board of Trade for arbitration.

Lincoln.—Referring to some remarks passed at the annual meeting of a local firm, Ald. White stated that the Corporation had supplied them with 802,000 units in the year to March, 1915, 1¼ million units in 1916, and 3¼ million units in the year ended March, 1917. They had had to utilise some of their old plant, as they could not obtain the necessary permission to borrow money for new plant during the war.

Liverpool.—At a recent meeting of the City Council, Mr. Gates protested against an expenditure by the Electricity Committee on two new cooling towers at Lister Drive power station and two rotary converters and switchgear. He complained that this capital expenditure, which he estimated at £30,000, was in contravention of Government policy, and alleged that the business of the Committee was settled without tenders being invited. The Committee's recommendations were approved.

London.—The Battersea Electricity Committee recommends that an additional 5s. per week wages be granted to all employés, and 2s. 6d. per week to boys and women, the increase to date from April 1st. The recommendation will not apply to fitters and fitter's mates whose cases were dealt with previously.

HACKNEY.—The Electricity Committee has decided to recommend a general increase in the price of electricity for all purposes, except as regards slot-meter supply.

New Zealand.—An interim report by Mr. Evan Parry on the hydro-electric development of the North Island has been published. The best scheme involves three water-power sources to supply Hawke's Bay district, Auckland district, and Wellington district. For Auckland, the taking over of the Hora Hora works of the Waihi Co. was considered; but the best source of power, eight miles away from Hora Hora, is in the Arapuni Gorge, where 120,000 H.P. could be obtained on a 50 per cent. load-factor basis. Mr. Parry considers that this scheme would be justified if only 40,000 H.P. were developed in the first instance, and that the cost of such a plant, with transmissions for serving surrounding towns and districts, would amount to £1,200,000. The most suitable source of power for the supply to Wellington is the Mangahao River, where 25,000 H.P. can be obtained on a 50 per cent. load-factor basis; in time, another source of power in the Taranaki district might be developed to supplement this. The hydro-electric plant would cost about £420,000, while transmissions would bring the total up to £1,000,000. A modified scheme suggested would cost £448,000. It is proposed that instead of providing spare hydro-electric plant, a portion of the existing Wellington steam plant should be utilised. Mr. Parry considering that this would have advantages in security over water plant, which is subject to low-water difficulties.

Peterborough.—The T.C. has decided to extend the supply cable to the works of the Birmingham Wagon Co., who will pay part of the cost.

Rochdale.—The Electricity Committee is recommending that the price of energy for power and traction be increased by ·3d. per unit instead of the present 15 per cent., and for lighting by 25 per cent., instead of the present 10 per cent. A coal clause is to be introduced in future contracts, and it is expected to obtain an extra revenue of £10,000 a year.

Salford.—YEAR'S WORKING.—The following particulars have been given in the local Press as to the working of the electricity undertaking during 1916-17:—The energy sold increased from 20,650,000 units to 24,856,000 units; the revenue increased from £115,847 to £133,764, the gross profit from £50,807 to £63,625, and the net profit from £8,406 to £16,598, as compared with the previous year. This is the largest net profit ever earned in one year, and is due more particularly to the introduction of modern plant, which has led to the reduction in coal consumption from 4·8 lb. two years ago to 3·2 lb. per unit generated, which is equivalent to a saving of 15,000 tons of coal per annum. On the other hand, increases have occurred in taxes, sinking fund, fuel cost, wages, &c., and increased rates of charge have been made, which brought in £4,700; but as the extra output was at power rates, the average rate received per unit had not increased.

The modernisation of the plant was being carried out without increasing capital indebtedness; a 5,000-KW. turbine plant recently added was being paid for from the renewals fund, and re-covered cables to the value of £14,500 last year, and £25,000 this year, would be set off against the cost of H.T. extensions which were being made.

Sheffield.—WOMEN STOKERS.—The Electricity Committee proposes to pay women stokers 6½d. an hour for all time worked, exclusive of the war bonus of ½d. an hour paid to all women workers.

Application is to be made to the L.G.B. for permission to raise £15,000 for the electricity undertaking, for sub-stations, &c.

Southport.—PRICE INCREASE.—An increase of 5 per cent. in charges for electrical current is recommended, to operate as from Midsummer Day.

Stockport.—PROPOSED LOAN.—The T.C. has applied, with official sanction, for permission to borrow a loan of £27,500 for the provision of a 5,000-KW. turbine set for the electricity works.

Stoke-on-Trent.—PRICE INCREASE.—The T.C. has decided to make a further advance of 5 per cent., making in all 25 per cent. since the war began, on the charges for current from and after the end of the June quarter. The B. of T. has sanctioned the supply of current to the premises of a firm in the area of the Leek R.D.C. and to a works in the area of the Smallthorne U.D.C.

Swansea.—LINKING-UP.—The borough electrical engineer has reported on the suggested linking-up of Swansea, Llanelly, and Neath, which offers considerable possibilities as to interchange of load, &c. It is hoped to make some definite proposal within the next few months.

York.—The Electricity Committee recommends an advance of 1d. per hour in wages to the men employed at the generating station, who are not confined within the award of the Committee on Production regarding the engineering and foundry trades.

TRAMWAY and RAILWAY NOTES.

Accrington.—ELECTRIC VEHICLE.—A new battery-driven dust van has been brought into use by the T.C.

Ashton-under-Lyne.—TRAMWAY PURCHASE SCHEME.—The Bill promoted in Parliament by the Corporation for the purchase of the Oldham, Ashton, and Hyde Tramways now awaits final sanction. The opposition of the Ashton Master Carriers' Association and of the Hyde Corporation has been withdrawn. The Bill gives the Ashton Corporation power to purchase the tramways after six months' notice.

Australia.—The Premier of Victoria, Mr. W. Hutchinson, Mr. McLeod, Chief Secretary, and the Railway Commissioners recently inspected the new power plant, &c., at Newport, installed for the electric working of the railways; Mr. Jones, the Railway Commissioner, stated that the only cause of the delay in the completion of the electrification scheme was the shortage of switchgear, but he hoped to have everything in readiness for a start by the due date in January next.

TRAMWAY ARBITRATION AWARD.—The Melbourne Tramways Board has issued a summons for an order that the award of Mr. Justice Cussen in respect of the assessment of the property of the Melbourne Tramways Co. be set aside, on the ground that his Honour was wrong in law by giving effect to the principles enunciated in the award, and, alternatively, that Mr. Justice Cussen should have stated a special case on the matter for the opinion of the State Full Court.—*Melbourne Age.*

Blackburn.—RAIL SHORTAGE.—The T.C. has referred back a recommendation that the rails on the Cherry Tree section should be taken up, so as to replace the worn-out rails on the Preston Road route. It was pointed out, however, that the Committee saw no way of continuing the service unless some route was closed, and the rails utilised elsewhere. Councillor Higham said they could not get the rails, as they were not being rolled; Leeds had obtained a tender from America, at £22 a ton, with problematical delivery in 18 months' time.

The Tramways Committee has decided against the request of the Workers' Association for an increase of 10s. per week in wages.

Doncaster.—INCREASED FARES.—The T.C. has adopted the recommendation of the Electricity and Tramways Committee, advancing the fares on the Bentley route (as mentioned in the ELECTRICAL REVIEW last week), Mr. Balmforth mentioning that the journeys were longer for the fares than on any other route in the town.

Glasgow.—REVENUE RETURNS.—For the third successive week the revenues of the tramway department have reached record figures. Last week they reached £25,914, as compared with £23,174 in the corresponding week of 1916, while the passengers carried numbered 8,005,687 and 7,295,746 respectively. Since the beginning of the present financial year on June 1st, 1916, the receipts have been £1,148,840, against £1,058,550.

Leeds.—WAGES.—The Government arbitrator's award in a recent application by the Tramway Workers' Union for increased wages is as follows:—The war bonus for men over 21 years of age is increased to 7s. per week all round; such increase is in substitution for all previous war bonus allowances. As regards women, the award is half of the said bonus, after three months' continuous employment, three-quarters of the bonus after nine months, and the full bonus after twelve months; this award to be in substitution for any previous award as regards women workers made in October last year. The bonus is to be paid, and to take effect, as from April 1st of this year.

Sheffield.—Arrangements have been made under which the work of car cleaning will be carried out by the extended use of female labour. The male car cleaners in the tramway department are to transfer their services to the cleansing department, on the understanding that they have the right to return to tramway work at the close of the war. The Tramways Committee reports that the estimated cost of war allowances granted to employés, or about to be granted to employés, for the current year amounts to £51,316; the estimated cost of allowances to dependents of employés on war service is £12,500, and the estimated increase in the cost of electrical energy for the current year is £15,600. In order to enable the Committee to deal with the foregoing, which make a total of £79,416, it is intended that ½d. stages for adults on all the routes be abolished.

South Africa.—The Johannesburg Municipal Council has prepared a scheme for extending the tramways to Newlands. Three methods have been considered: (1) Extending the electric tramway; (2) using motor tramways; and (3) running a 'bus service. The Committee explains that the motor tramway proposal involves the construction of a track without any electrical equipment, and the running of self-contained motor vehicles. The Committee said that there was no doubt that, with a suitable type of vehicle and under certain conditions of running, the use of motor tramways would prove a success, and such vehicles would probably be run at less cost than heavy electric cars. The proposals are still under consideration

South Staffordshire.—WAGES.—The Birmingham and Midland Tramways Co.—including the South Staffs., Wolverhampton and district, and Dudley and district branches—has conceded an increase in war bonus to its employés of all grades.

St. Annes.—As the result of a meeting between the Council and the Blackpool, St. Annes and Lytham Tramways Co., Ltd., a satisfactory basis for a new agreement for the supply of electricity to the tramways has been arrived at. The old agreement, concerning which there was some criticism from Lytham some time ago, terminates at the end of June.

Warrington.—YEAR'S WORKING.—The tramway department has made a net profit of £2,050 on the year's working, as against a net profit of £2,620 for the previous year. The total income was £26,462 and the expenditure £18,795, leaving a gross profit of £7,667.

Wolverhampton.—The Corporation has decided to submit the question of increased wages to the tramway employés to arbitration.

York.—During the year ended March 31st last, the number of passengers carried on the city tramways was 8,500,063, the car-mileage was 829,096, and the receipts 10·47d. per car-mile. The electric omnibuses carried 642,943 passengers, the car-mileage being 77,059, and the receipts 8·01d. per mile. The Committee reports that the cost of the electricity used for the omnibuses has been £737, whereas if petrol had been used, the cost would have been considerably over £1,000.

TELEGRAPH and TELEPHONE NOTES.

German Wireless.—The Republic of Liberia has broken off relations with Germany.

The adhesion of Liberia should bring about the complete removal of German trade and influence from West Africa and the final suppression of the transmission of German wireless news in that region, Liberia being the only region of West Africa not in Allied occupation.

Holland.—It is reported that, with the co-operation of the principal Dutch shipping companies, a company has been formed at Amsterdam under the title of the Dutch Telegraph Co. Radio-Holland, and with a share capital of £83,000. The object is to substitute apparatus of Dutch manufacture for the wireless equipment used on Dutch ships, and supplied and worked almost exclusively by the Société Anonyme de Télégraphie sans Fil, of Brussels. The work is to be carried out on the expiration of existing contracts, in order to emancipate Holland from an external monopoly in its communication with the Dutch Colonies.

Illicit Wireless Telegraphy.—At Portsmouth Police Court, on May 7th, an electrical apprentice named R. G. H. Cole, employed in Portsmouth Dockyard, was charged under the Defence of the Realm Act with being in possession of wireless telegraphic apparatus without the permission of the Postmaster-General. On visiting the prisoner's residence at Southsea, a detective found attached to a 15-ft. clothes-pole, three fine wires similar to those used as aerials in wireless telegraphy. In Cole's bedroom he found a table, on which was apparatus attached to the aerials, and in working order. Prisoner, who said he could only receive messages, was remanded for a week in custody.—*Daily Telegraph.*

CONTRACTS OPEN and CLOSED.

OPEN.

Keighley.—May 15th. Electrical installation at the Ward block, at present in course of erection at the War Hospital, Morton Banks. Specifications from H. Webber, Borough Electrical Engineer.

Manchester.—May 11th. Electricity Committee. Stuart Street generating station. (*a*) One hydraulic accumulator and electrically driven ram pump, (*b*) coal conveying plant. Mr. F. E. Hughes, Secretary, Electricity Department.

Warrington.—May 22nd. Electricity and Tramways Committee. Underfeed mechanical stoker. See "Official Notices" May 4th.

CLOSED.

Bolton.—The Sanitary Committee has accepted the tender of the Corporation Electricity Fittings Department for the conversion of the plant at the laundry at the Western Fever Hospital from steam to electric power.

Bradford.—Electricity Committee. E. Green & Sons, Ltd.: Improved patent fuel economiser, in place of one at Valley Road Works, £2,086.

Dewsbury.—Electricity and Tramways Committee. Coal. Crawshaw & Warburton, Ltd., 2,000 tons; J. Longbottom & Sons, 1,500 tons of Barnsley slack; J. Longbottom & Co., 500 tons of Barnborough slack.

Glasgow.—The Committee on Works and Stores recommends acceptance of the following offers for annual stores :—

Ozokerite tape.—I.R., G.P. & Telegraph Works Co., Ltd.
Trolley wire.—F. Smith & Co., Ltd.
Axles and steel tires.—Brown Bayley's Steel Works, Ltd.

Sheffield.—City Council. Accepted tenders :—

Willans & Robinson, Ltd.—Increasing the capacity of No. 3 turbo-alternator from 4,500 kw. to 6,000 kw.
G. Heathcote & Co.—14 steel ventilating shafts for coal store.
Electricity Supply Department of the Corporation.—22½-h.p. motor for the Health Department, £86.
John Brown & Co., Ltd.—500 steel tramway tires, at 7s. 6d. per tire.

Swansea.—The Electric Lighting and Tramways Committee has renewed the coal contract with the Main Colliery Co. for the ensuing year at the same price as paid last year.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 11th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Works Records," by Mr. F. D. Napier.
Friday, May 18th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Metric Weights and Measures and Decimal Coinage," by Mr. E. C. Barton.

Salford Technical and Engineering Association.—Saturday, May 12th. Visit to Messrs. H. Wallwork & Co.'s works, Manchester.

Royal Institution of Great Britain.—Saturday, May 12th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.
Friday, May 18th. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Complexity of the Chemical Elements," by Prof. F. Soddy, F.R.S.

Birmingham and District Electric Club.—Saturday, May 12th. At 7 p.m. At the Swan Hotel, New Street. Paper on "Electric Furnaces for Nitrates from the Air," by Mr. E. Kilburn Scott.

Illuminating Engineering Society.—Tuesday, May 15th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Annual meeting. Discussion on "Economies in Lighting in relation to Fuel Saving."

Institution of Electrical Engineers.—Thursday, May 17th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Annual general meeting. At 7 p.m. Special general meeting to consider proposed additional Articles of Association.
(Newcastle Local Section).—Monday, May 14th. At 6.45 p.m. At the Mining Institute. Annual general meeting.

Institution of Mechanical Engineers.—Friday, May 18th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "The Construction of Turbine Pumps," by Mr. A. E. L. Chorlton.

NOTES.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week. Lieut.-Colonel Clay, V.D., Commanding :—
Monday, May 14th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill No. 3 Company, Left Half Company. Signalling Class.
Tuesday, May 15th.—Lecture, 6.30, Captain Castell, "Knots and Lashing and Trestle Bridging." Physical drill and bayonet fighting, 7.30 to 8.30.
Wednesday, May 16th.—Drill, No. 1 Company, Right Half Company, 6.15.
Thursday, May 17th.—Drill, No. 2 Company, Right Half Company. Ambulance Class by M.O., 6.30. Signalling Class.
Friday, May 18th.—Technical for No. 3 Company, Left Half Company, Regency Street. Drill No. 3 Company, Right Half Company. Recruits' Drill, 6.30 to 8.30.
Saturday, May 19th.—Commanding Officer's Parade, 2.45. Uniform for Drill in Hyde Park.
Sunday, May 20th.—Special work at Bombing School. Parade, Clapham Common Station (City and S.L. Tube Railway), 9.45 a.m.
Armlets.—Members are warned that armlets must be worn at all plain-clothes parades.

(By order), MACLEOD YEARSLEY, *Captain and Adjutant.*

Books for British Prisoners of War.—The British Prisoners of War Book Scheme (Educational) is the only War Charity which provides educational books for the thousands of our men, now in enemy hands, who are craving for solid literature with which to improve their minds and relieve the tedium of their captivity, in accordance with their expressed needs, and the continued requests for books which daily reach the chairman from the camps, coupled with the regular acknowledgments of parcels, show that its consignments reach their destinations, and that never was the work it is doing in this field more necessary or more appreciated than at present. Our readers are earnestly requested to send to the Scheme a list of any volumes they can spare. They will then be advised as to which books will be of use. The organisers have no need of fiction, and no use for out-of-date technical books, or books in bad condition; they also have a sufficiency of works in the dead languages.

Those who care to know something about the really great educational work which is going on among British prisoners may be interested in reading a little booklet entitled "Student Captives," which has just been published, and which may be had on application to Mr. Alfred T. Davies, chairman of the British Prisoners of War Book Scheme (Educational), at the Board of Education, Whitehall, S.W., 1, to whom all communications should be addressed.

Education of Engineers.—In connection with the scheme of education recommended by the Council of the Institute of Marine Engineers, and noted in our pages, the following extract from the *Glasgow Herald* of March 23rd is quoted in the *Transactions* of the Institute :—"Glasgow School Board, at their meeting yesterday, had an offer before them by an engineering firm, Messrs. Barr & Stroud, to co-operate in the education of their future apprentices by means of scholarships. In their letter the firm stated that as they were of opinion that it would be to the advantage of apprentices that they should stay at the day schools until they were at least 15 years old, the firm, provided the year spent at school from 14 to 15 was devoted to subjects specially suitable for, and interesting to, engineering apprentices, had resolved to institute scholarships on the following conditions :—(1) The scholarships would be 10 in number, tenable for one year, of the value of £10 each; (2) they would be awarded to boys of the age of 14 recommended by the headmasters of certain selected schools, certified as medically sound, and approved by the firm; (3) they would be tenable at a school in which a course of instruction in mathematics and practical physics suitable for engineer apprentices could be followed; (4) the boys, before taking up the scholarship, would sign an agreement to serve five years' apprenticeship with the firm to the trade of instrument-making or of engineering." The proposal was remitted to a Special Committee for consideration and report.

The Electrical Trade Position in South Africa.—The sudden stoppage of new electrical connections by the Johannesburg Municipality has given rise to the idea that relief may be obtained from the Victoria Falls Power Co. In the meantime, the Municipality is adamant. For example, an estate company, which had been negotiating before the stoppage, wanted four cottages supplied with electric light, and they were not only willing to pay the ordinary charges, but any extras owing to the increased cost of materials, but the several answers have been that the town's cables and transformers are loaded up to the full. The Municipal authorities had reached their limits in anticipation of the new power plant, ordered in Britain, arriving shortly, but now this has been refused a permit, therefore there is no alternative but to stop new connections. It stands to reason that the Johannesburg Municipality will not remain dormant, but will look around to see what can be done to obtain the necessary power plant from other sources, as the stoppage of electrical connections will hamper building operations very considerably, as no up-to-date shop or residence can be considered complete without electric light. We cannot expect much relief from America, as their standard gauges for plant do not always fit in with those in use here. As regards Japan, they have not got over the initial troubles of catering for a new market. What happened over a year ago was that travellers offered our merchants a nice lot of Japanese assorted electrical ware, from samples, at prices that had never been heard of before in Johannesburg, but these goods have not yet materialised. However, a Birmingham house has recently supplied Johannesburg with Japanese electrical goods, but the cost is about four times as much as originally quoted from Japan. However, there is a Japanese house of representatives established in Cape Town, and it is said that representatives in Johannesburg are now guaranteeing or promising direct deliveries from Japan, delivery c.i.f. Durban, which would soon enable our Municipality to carry on, much as usual. In the ordinary way, the engineering shops in Johannesburg are doing a lot of electrical work, chiefly in re-fixing and re-making, rather than new work, although quite a creditable quantity of the latter is made when specially ordered and paid for at a price about five times higher than the imported, but obviously when things are wanted, and must be had, the price is a secondary matter. Until about six months ago, the stocks of electric lamps were in plenty, but now the wholesale prices have risen, and the cheapest retail price for the ordinary house lamp is 2s. On the whole, supplies of ordinary electrical goods are plentiful, but the exceptions are always with us, and these seem enlarging of late. For example, 3/20 coils of wire have sharply risen to 30s., but within two sizes different, viz., 3/22, which can be had at 21s. 6d. There is a great shortage of heavy copper wire and cables in merchants' stores, but the mines have plenty. The smaller sizes of wire and cables, from a general standpoint, seem to be amply available.—*South African Mining Journal.*

The same contemporary in a later issue just to hand says:—"Material is getting scarce through the absence of oversea supplies, which are not sufficient to fill up the absorption. All kinds of electrical tubing are so scarce that substitutes in the shape of water and steam piping are occasionally used to complete an urgent job. Keyholders and switches are also very scarce. Much was hoped for from Japan, but some of the optimistic anticipations have not yet been realised. However, from that source we are getting ceiling roses, lamp-holders, cut-outs, counter-weights and switches. Cables are yet to come, as a bad start was made in the first orders, as it was found that the Japanese standard was different to ours, but they are now making some strictly in accordance with our requirements. One reason of the stocks being scarce in town, is that the municipalities, railways, and other big users of electricity secured quantities of stock at the first signs of a shortage. The mining companies were, however, first in the field some two years ago, when stocks were super-abundant, hence they have good general supplies, with the exception of lamps."

Mobilisation of Chemical Industries.—Sir Charles H. Bedford, secretary of the Association of British Chemical Manufacturers, delivered an address entitled "Mobilisation of British Chemical Industries for After-War Conditions," to the members of the Birmingham and Midland Section of the Society of Chemical Industry, last week. The lecturer outlined the organisation which had been developed with a view to meeting after-the-war conditions, and which had resulted from the realisation by the experience of the war of the proved and urgent necessity for some form of combination among the chemical manufacturers. Having explained the organisation and membership of the Association, he said the tendency was for the large firms to come more closely together, and it would only be through the Association that they would get the smaller firms to come into line. But when they did come into line, they would find there was a great deal to be said for the pooling of interests, and that on the balance it worked out very satisfactorily. Manufacturers would come to see that other manufacturers of their own nation were not to be regarded merely as rivals to be fought, and that the conditions after the war would be so strenuous that they would be driven to combine against their common adversaries, particularly the Germans. Co-operation would steady prices and reduce waste in production, and it must be conjoined with aiming at the highest technical and commercial standards.—*Birmingham Daily Mail.*

Educational.—The Board of Education has issued the draft of the proposed revised regulations for continuation, technical, and art courses in England and Wales, which it is intended to bring into force after the war. The draft deals especially with "Further Education," which falls outside the scope of the secondary school and the University, and relates in part to junior technical schools, "local and central colleges," &c.; it aims to provide a complete and systematic plan of further education in each area, properly related to elementary and secondary schools and universities, adapted to local needs, and particularly industrial needs, and offering to every student facilities for a graduated and progressive course of instruction. The Local Education Authority will be the body responsible for formulating and carrying out such a plan, and upon it will be devolved many of the matters at present supervised by the Board. The term "Local Colleges" is a new title conferred upon the larger and more advanced schools in recognition of their distinctive status and position, and the higher technical and research work carried on in them will be developed. The need for securing the interest of employers and workpeople in technical instruction, and for obtaining teachers with trade experience for such instruction, is recognised, and the importance of continuing general education side by side with technical instruction is not overlooked. The advantages of co-operation between Local Education Authorities are emphasised, and the possibility of promoting the adequate and efficient provision of "further education" by the formation of joint bodies working in connection with two or more Local Education Authorities is looked upon with favour by the Board.

Excess Profits Tax.—In his Budget speech the Chancellor of the Exchequer raised the Excess Profits Tax from 60 per cent. to 80 per cent. In replying to the Debate, he spoke as follows (according to the *Times* report):—

"As regarded excess profits, he had been surprised to find how little had been said by those who would have to pay the duty. He recognised that it was an extremely heavy tax, and one which would inevitably have bad effects on our trade after the war. But that was true of all taxation on this scale, and the problem which the Chancellor of the Exchequer had to face was this: Was the taxation necessary to get the additional revenue, and, if so, what was the best way of getting it both from the point of view of fairness and national interest? He had not the smallest doubt that it was better from both points of view to take the money in the form of excess profits duty than to add to the income-tax at the present time. The hon. member who spoke first in the debate (Mr. Annan Bryce) contrasted the position of companies after the war in this country with that of those in Germany, and had said quite truly that in Germany there was nothing like our excess profits duty, and assumed that German companies would be in a much better position than ours after the war. Why had Germany not been able to get taxation of that kind? He thought the explanation was the same as the cause of the war—namely, that the German Government was in the hands of a small but vocal class, and they dared not apply to that class measures in the interests of the war which they applied freely to other classes which did not control the Government of the country. What was the effect? It was quite true that they did not put on excess profits, but the hon. member had mentioned the name of a company which had a surplus of several millions sterling. He was sure that that sum was lent to the German Government. After the war our industry would not revive unless there was credit, nor would the German industry, and the basis of the credit of firms in this country would depend on the basis of the credit of the country as a whole. Therefore in his view it would probably be found that credit here would be better than in Germany, because we had had the courage to use our revenue to meet our expenditure, and therefore to improve the whole standard of our national credit. Dealing with the question of double income-tax, he said he had always thought that it was unfair as it existed now, and would have to be altered; but this was not a time to give up revenue. He had discussed the matter with the representatives of the Dominions, and it had been discussed at the Imperial Conference. While the representatives of the Dominions urged that the question should be dealt with, they suggested that it should be put right immediately after the war. If he was in a position that enabled him to have any influence then, he should certainly urge that it was one of the earliest questions to be considered."

German Union of Technical Institutions.—The Union of German Technical Institutions (Deutscher Verband Technisch-Wissenschaftlicher Vereine), which will, doubtless, be organised and administered with characteristic thoroughness, and which will, therefore, constitute an important factor in the coming industrial struggle, has lately been strengthened by the accession of five more institutions. The affiliated bodies are now:—Verein Deutscher Ingenieure (Union of German Engineers); Verband Deutscher Architekten und Ingenieur Vereine (Architects' and Engineers' Society); Verein Deutscher Eisenhuttenleute (Ironworkers' Association); Verein Deutscher Chemiker (Chemical Society); Verband Deutscher Elektrotechniker (Electrical Engineers); Schiffbautechnische Gesellschaft (Shipbuilders); Deutscher Verein von Gas und Wasserfachmannern (Gas and Water Engineers); Verein Deutscher Strassenbahn und Kleinbahnverwaltungen (Tramways and Light Railways); Verein der Zeilstoff und Papierchemiker (Cellulose and Paper Chemists); Wissenschaftliche Gesellschaft für Luftfahrt (Aerial Traffic); Gesellschaft Deutscher Metallhütten und Bergleute (Metal Workers and Miners). The potentialities of a union embracing the resources of these institutions are not to be underestimated. The Administrative Committee consists of Geh. Reg.-Rat Dr.-Ing. Busley (Berlin), and Kgl. Baurat Dr.-Ing. Taaks (Hanover), as president and vice-president; Dr. Diehl (Berlin-Lichterfelde), as managing director, and Prof. Klingenberg (Berlin), Geh. Baurat Saran (Berlin), Kommerzien-rat. Dr.-Ing. e.h. Springorum (Dortmund), as members.

Central Station Employes.—With reference to the letter from Mr. W. J. Ebben, hon. general secretary of the Association of Electrical Station Engineers, appearing in our last issue, we understand from a correspondent that the national engineering awards have now been extended, and full particulars are given in a leaflet which has been issued by the Electrical Trades Union. The London Power Station Engineers' Branch of this Union is at 7, Levendale Road, Forest Hill, S.E., and Mr. H. H. Morton is its secretary, from whom information may be obtained. The leaflet referred to prints in full the finding of the Committee on Production respecting the Union's application for an advance, also the memorandum of agreement between the Engineering Employers' Federation and the Electrical Trades Union, arrived at in February, 1917. There is, further, printed a copy of a letter received from the Ministry of Munitions, intimating that the Minister has decided that "he is prepared to take such steps as may be necessary to secure that any award given in the trade in question shall be applied to non-federated controlled establishments." From the foregoing it will be obvious that the awards apply to power and sub-station members who are employed in controlled establishments, and those who are interested in the matter should apply to either Mr. Morton, as above, or to any of the Electrical Trade Union's many Branches, of which there are 137 throughout the country.

The New Trade Bank.—The *Times* states that the formation of the British Trade Corporation, the title of the British trade bank which is being floated under Government auspices, has reached an advanced stage, for copies of its prospectus have now been circulated among interested parties. The nominal capital of the institution has been fixed at £10,000,000, but the first issue will be limited to a quarter of that amount, £2,500,000. Lord Faringdon, who presided over the Committee which recommended its formation, has been appointed chairman, and Mr. F. Dudley Docker, who has taken a special interest in the scheme, managing director. The Right Hon. F. Huth Jackson is a member of the board, which also includes the names of directors of certain other large banks. Our contemporary says:—"Although bankers generally are sympathetic towards the new project on account of the benefits which it is expected to confer upon British trade generally, it must be said that they are rather apprehensive as to the effect of some features of the scheme. It is understood that the new corporation intends to make a special feature of the acceptance business, a branch of banking in which considerable strides have been made by the existing banks since the outbreak of war, owing partly to the suppression of the German institutions. Bankers, therefore, are inclined to look upon the newcomer as a possible formidable competitor, and though a number of them will probably subscribe a part of the capital required, the response to an invitation to do so would, no doubt, have been much more cordial had the scope of the corporation's activities been confined to those branches of finance which are outside orthodox banking practice."

In referring to the above scheme in the House of Commons on April 26th, Mr. G. Roberts said, according to the *Times*, that His Majesty's Government had promised the British Trade Corporation their sympathy and support. The Corporation had received a Royal Charter establishing it for a term of 60 years, and Clause 4 of the Charter conferred on it the right under certain circumstances to act as agent of the Government subject to the Government being entitled to appoint their own agent in any special case in which such a course might appear to be necessary or expedient. The corporation had been brought into being with the object of assisting British trade and industry, and failure on the part of the corporation to give effect to that object would expose it to the liability of proceedings being taken to annul the Charter. The corporation was also under terms to remain British in character and free from foreign control. There would be no subsidy or guarantee, and no monopoly in any form.

It is announced that the names of the first directors of the Corporation are:—Lord Faringdon, Mr. F. Huth Jackson, Mr. Arthur Balfour, Mr. F. Dudley Docker, Mr. W. H. N. Goschen, Mr. J. H. B. Nobel, and Sir J. Hope Simpson.

The Boy in Industry.—Dr. Addison, M.P., the Minister of Munitions, states that the number of boys between the ages of 14 and 18 engaged in various occupations in this country is approximately 1,250,000, and that "their young shoulders are gallantly helping to support the burden of war." But while the war has heightened the value of the boy in the labour market, it has intensified the problem of his welfare, and the Ministry of Munitions has issued a pamphlet on the subject, which Dr. Addison commends to the attention of parents, employers, social workers, and teachers, in the hope that the problem may be brought nearer solution. "The Boy in Industry" (H.M. Stationery Office, Kingsway, London, W.C. 2. 3d. net) puts the case of the factory lad clearly and without concealment of unpleasing facts. The ordinary boy of 14 to 18 years, states the author, is "unstable, wilful, elusive; the age is a critical one in his career, and he is receptive to influences both good and bad—chiefly bad." To-day, various contributory causes make his position more precarious; the father's control is absent, and high wages are paid for his labour. "The boy knows nothing of the part he is to play, either in the world or in his work," and finding himself regarded as a man, he thinks that the sooner he apes man's follies, the better. Various methods have been devised to stay this national waste, but the social and recreative agencies at work are insufficient. "A more highly-developed system of engagement and control" from inside the industrial system is essential. This could be accomplished, the author insists, by the appointment in the factories of a sympathetic supervisor, who would watch the personal interests of the boys. This officer would engage all the lads, would keep in touch with them at work and at play, and would encourage them in a wholesome outlook on life. The booklet is a very interesting and timely one, and does not take long to read—an important consideration just now. We recommend those concerned with the position of boys in industry to study it, and to obtain the scheme for boy supervision in munition factories from the Welfare Department, Ministry of Munitions, 6, Whitehall Gardens, London, S.W. 1.

Hydro-Electric Power in France.—The American Manufacturers' Export Association appointed last year an American Industrial Commission to visit France for a first-hand study of present industrial conditions and future possibilities. Dr. C. O. Mailloux, a past-president of the American Institute of Electrical Engineers, was the electrical member of the Commission, and during his stay of several months abroad, prepared extensive notes on hydro-electric developments in France, with special reference to the electrochemical and electrometallurgical industries.

Before the war, the annual coal consumption in France was, in round numbers, 60,000,000 tons, of which amount about 40,000,000 tons were obtained from French coal mines, leaving a shortage of about 20,000,000 tons to be made up by importation from other countries. About 45,000,000 tons are used for producing steam for generating mechanical power, aggregating about 12,000,000 H.P., so that the full development and utilisation of 6,000,000 H.P. of water power would, theoretically, more than make up for the entire coal shortage in the whole country. This indicates the immense national importance of water-power developments for France.

Dr. Mailloux states that the aggregate power capacity of all the water powers owned or exploited by the various power companies belonging to the Water Power Association is 660,000 H.P. Of this total, 412,000 H.P. represents power transmitted and distributed for general lighting and power purposes in cities, towns, and villages; the rest (248,000 H.P.) is power consumed by electrometallurgical and electrochemical industries. The distribution systems owned by the power companies belonging to the Association constitute a network of 16,200 km., of which 13,400 km. are overhead lines, and the rest (2,800 km.) are underground. These distribution systems serve to supply electric current for light and power to communities aggregating between 4,500,000 and 5,000,000 inhabitants. The capital investment represented by all these plants exceeds 600,000,000 fr.

As there are many water powers in the Alps and elsewhere operated by companies and individuals not members of the Water Power Association, the above statistics are incomplete. The complete statistics for January 1st, 1916, for the region of the Alps are as follows:—

	H.P.	Per cent. of total.
Power used for light and power	291,000	39·4
Power used for electrometallurgical works	255,000	34·6
Power used for electrochemical works ...	147,000	19·9
Power used for electric traction	16,000	2·2
Power used for paper mills, saw mills, &c.	23,000	3·1
Power used for various industries (lime and cement works, spinning, &c.)	6,000	0·8
Total	738,000	100·0

The 1916 map of a Government Commission charged with the work of estimating the hydraulic resources of France, gives the following additional information for the same region:—Power plants under construction or for which contracts have been made, 100,000 H.P.; water powers whose development is contemplated or proposed, 700,000 H.P. The two most important new water-power projects are the Durance and the Upper Rhone projects.

Interesting figures are given on the rates charged for electrical energy in France, with special reference to Lyons and St. Etienne. At Lyons the KW.-hour is charged at 60 centimes for domestic lighting, at 55 centimes for stores, offices, and factories, at 50 centimes for hotels, cafés, restaurants, theatres, churches, schools, &c., and at 40 centimes for small power consumers. Discounts from 2 to 20 per cent. are allowed, according to the amount of the yearly bill At St. Etienne, 55 centimes are charged per KW.-hour for lighting for the first 1,000 KW.-hours, but the rate is 50 centimes for the next 400 KW.-hours, &c., and 30 centimes for all above 3,300 KW.-hours. The minimum price for metered power current comes down to as low as 5 centimes per KW.-hour in St. Etienne as well as at Lyons. This is a very low figure, which prevails only where hydro-electric power is available. At Bordeaux, where black coal is the only source of power, the power used for operating the coal and ore-handling and conveying system at the Bordeaux docks costs 12 centimes per KW.-hour. This is regarded as a low figure for electric power current derived from a steam station, even allowing for the advantage which a seaport city has of being able to get its coal supply at a lower rate than an inland city. Nevertheless, this very reasonable cost is still 2·4 times greater than the lowest cost of electric power at Lyons and at St. Etienne, which is a significant fact.—*Electrical World.*

Excess Profits Duty: Electrical Cables.—On the application of the Cable Makers' Association for an increase of the statutory percentage in respect of the business of manufacturing in the United Kingdom insulated wires and cables for the transmission of electrical current, the Board of Referees has ordered that the statutory percentage shall be increased to 7 per cent. in the case of business carried on by a company or other body corporate, and to 8 per cent. in the case of any other trade or business.

Fatality.—Archibald Thompson, 33, was killed at the Wallsend power station of the Newcastle Electric Supply Co., on April 30th. Thompson, who was works foreman for Messrs. McAlpine, contractors, was standing near a beam, which was supported on a concrete pillar. The beam slipped off the pillar, and struck Thompson on the head and fractured his skull.—*Newcastle Chronicle.*

Poster Restrictions.—The following letter has been issued by Mr. H. C. Hill, chairman, Colour Printers' Committee of the London Master Printers' Association :—

"There appears still to be some doubt and misconception among advertisers as to what is permitted under the above order as recently amended. May I, therefore, ask for a little of your space briefly to state the present position with regard to posters :—

"1. New posters may be produced up to 60 in. by × 40 in. size, or its equivalent in square inches.

"2. Posters in any size—including those advertising goods offered for sale by retailers—with or without the retailer's address, the production of which was commenced before March 2nd, may be completed and exhibited on hoardings and elsewhere, as before.

"3. There is no restriction on the exhibition of posters of any size or kind which were in stock on March 2nd, excepting those making an announcement with respect to a newspaper or periodical.

"4. Posters for export can be printed in any size.

"Official confirmation of above appears in a revised explanatory note on the Paper Restrictions Order, issued on April 18th, a copy of which may be obtained at H.M. Stationery Office, Kingsway, London, W.C., 2, or other Government publishers."

Institution and Lecture Notes.—Association of Mining Electrical Engineers.—At a meeting of the WEST OF SCOTLAND BRANCH of the Association at Glasgow last Saturday, Mr. J. P. C. Kivlen read a paper on "Some Aspects of Power Station Centralisation and Interconnecting Systems." A paper on "Electric Converting Machinery for Collieries" was read by Mr. C. S. Buyers.

Institution of Electrical Engineers.—At a fully attended meeting of the MANCHESTER LOCAL SECTION the following resolution was unanimously passed :—"The Committee of the Manchester Local Section of the I.E.E. desires to put on record its strong endorsement of the action of the Council in nominating Mr. C. H. Wordingham as president of the Institution for the session of 1917-18, and protests against the resulting attack which has been made on that gentleman in a section of the electrical Press. Being convinced that Mr. Wordingham will uphold the highest traditions of the office, the Committee wishes to assure him of its full support during his presidency."

Appointments Vacant.—Fitter-driver for the Clacton-on-Sea U.D.C. electricity works; switchman (50s.) for the City of Birmingham electric supply department; shift engineer (32s. 6d.) and stokers for the Borough of Gillingham (Kent) electric light and power department. See our advertisement pages to-day.

Decimal Coinage and the Metric System.—The adoption by this country of a decimal coinage and the metric system of weights and measures is one of the most important measures necessary to promote the after-war expansion of our foreign trade, as well as our internal efficiency. With Sir Richard Burbidge as chairman of an influential Executive Committee, the Decimal Association—according to the annual report just issued—has made remarkable progress during the past year in winning favour for this much-needed reform. Among the new members of the Association may be mentioned Sir H. H. Johnston, the Lord Mayor of Manchester, Sir Leo Chiozza Money, and Lord Northcliffe, who have been elected vice-presidents; another new member of the Executive Committee is Sir Hedley le Bas.

Nearly 400 Town and County Councils throughout the kingdom, and a number of Chambers of Commerce, and various important commercial and educational associations have come forward in support of the reform; and in response to a questionnaire of 25,000 of the largest firms in the kingdom, no fewer than 99 per cent. of the replies received were in favour of the metric system. Copies of the report can be obtained from the acting secretary of the Decimal Association, Finsbury Court, Finsbury Pavement, E.C., 2, from whom also may be had tickets for the meeting to discuss the reform, which is to be held at the Mansion House in June under the auspices of the Lord Mayor.

We have received from Mr. Harry Allcock, M.I.E.E., a reprint of the lecture which he delivered on March 27th on the above-named subject before members of the Institutions of Civil, Mechanical, and Electrical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute. Being the most complete and up-to-date exposition of the problem, the lecture was of exceptional interest and importance. Applications for copies or for permission to reprint should be addressed to the author at Radbourne, Hale, Cheshire.

Sicilian Sulphur.—The Minister of Munitions makes the following announcement :—In connection with the distribution of Sicilian sulphur, the Italian Government have allotted certain specified quantities to each of the Allied Governments, and requested that His Majesty's Government should purchase direct from the Italian Government the quantity allotted to Great Britain, and be responsible for its distribution. His Majesty's Government have agreed to this course, and the following Committee has been appointed to deal with the matter :—Mr. A. D. Cooper, Foreign Office; Mr. B. A. Collins, India Office; Mr. C. W. Dixon, Colonial Office; Mr. R. J. Thompson, Board of Agriculture and Fisheries; Mr. F. Gossling Board of Trade; Mr. R. A. Alston, Ministry of Munitions; Mr. H. S. Mingard (secretary), Ministry of Munitions.

In view of the increased demand for sulphur in connection with the production of explosives, it was found necessary, after careful consideration, that the export of sulphur should be prohibited, but provided every care is exercised to avoid waste in the use both of sulphur and of products and compounds in the manufacture of which sulphur is consumed, it is anticipated that agriculturists and manufacturers will not experience any great difficulties. The Committee has decided to offer to supply imported sulphur in lots of not less than 5 tons for use in approved trades and industries. The prices for the present will be:—Flowers of sulphur, £23 per ton; roll brimstone, £21 per ton; thirds, £12 10s. per ton, including delivery to the purchaser's nearest railway station.

From the prices mentioned above a discount of 2½ per cent. will be allowed to recognised sulphur merchants and dealers, but not to consumers. Applicants claiming this discount must furnish satisfactory evidence that they were recognised sulphur merchants or dealers before the war. The Committee understands that "recovered" sulphur can be procured, in the ordinary way of business, from the home producers. Application for sulphur must be made on special forms, which may be procured from the Secretary, Sulphur Committee, Ministry of Munitions, Explosives Department, Storey's Gate, S.W., 1. All applications must be accompanied by remittance of the purchase price in full.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Last week, the Mayor of Dudley presented Conductress G. SLIM, wife of a wounded Coldstream Guard, with the silver medal of the B.E.T. Co., Ltd., for displaying presence of mind and resource in a trying emergency, the medal being accompanied by a gift of £5 from the company. The proceedings took place at the offices of the Dudley and Stourbridge Tramways Co., at Brierley Hill. Mr. W. G. Bond, general manager of the Birmingham & Midland Tramways, mentioned that the medal was instituted 13 years ago, and only on about a dozen occasions had it been awarded to employés on the systems controlled by the B.E.T. Co. This was the first occasion upon which it had been awarded to a woman. On March 3rd one of their cars began to run back down Canal Bridge gradient, between Blackheath and Old Hill. Conductress Slim displayed great presence of mind; she pulled down the trolley pole, applied the brakes, and, what was equally important, allayed panic, and prevented passengers jumping off. She generally did her best to prevent what might have been a disaster, with the result that no personal injury occurred.

The Sheffield Electric Supply Committee has given to the Board of Trade, Control of Mines Department, a loan of the services of Mr. W. M. MILES, analytical chemist, to assist in the preparation of a coal redistribution scheme. The Tramways Committee has loaned the services of Mr. H. C. WATSON, chief assistant in the tramway department, to the Director of Shipyards' Labour Department of the Admiralty in connection with the organisation of the staff of the department.

Whitby U.D.C. has increased the salary of Mr. J. PIGGOTT, electrical engineer, by £20 per quarter.

At Bingley, on April 30th, the marriage took place of Mr. FRANCIS L. PEDLEY, manager of the Bingley District Council's electricity undertaking, to Miss Mary Read, of Bingley.

General.—Prof. JOHN TURNER MORRIS, of East London College, has, on his marriage to Miss MacGregor, changed his surname to MacGregor-Morris.

Mr. T. C. PARSONS, M.I.E.E., of the firm of Kiltall & Parsons, engineers, Glasgow, has been gazetted second-lieutenant, R.G.A.

Roll of Honour.—Corporal J. HAMILTON, R.E., who has been awarded the Military Medal, was an employé of Mr. T. C. Keay, electrical engineer, Dundee.

Rifleman G. W. A. HAZELTINE, K.R.R., who enlisted from the staff of Messrs. Trollope & Alls, electrical engineers, of Dorking, has been wounded in action.

Private E. A. EVES, R.W. Kent Regiment, who enlisted early in the war from the staff at Bromley (Kent) electric light works, has died of wounds received in action.

Private C. MANSFIELD, Essex Regiment, killed in action, enlisted whilst engaged at Marconi's Wireless Telegraph Works, Chelmsford.

Sergeant J. RYLANDS, who was an electrical engineer, and joined the S. African Infantry whilst holding a lucrative position at the Johannesburg gold mines, has died of wounds. He belonged to Widnes, and was trained at the works of the Electrolytic Co., Middlewich.

Flight-Sergeant J. CHETWOOD, who was in civil life an electrician, and belonged to Weston, Hawkestone (Salop), has been killed whilst making a trial flight with a machine at a home station.

Private A. Short, Trench Mortar Battery, killed in action, was prior to enlisting an assistant in the Stockport borough electrical engineer's department.

Private C. Franklin, Oxford and Bucks Light Infantry, who was on the staff at the Chipping Norton electric light station, has been killed in action.

Bugler A. E. Wilkins, Rifle Brigade, who was engaged in the generator department of the B.T.H. Co., Ltd., of Rugby, has been killed in action.

Private H. Wild, Devonshire Regiment, who joined up from the Rochdale Corporation tramway staff, has been killed at the Front by a shell.

Rifleman E. W. Lulham, Rifle Brigade, who was at the Weybridge electric light works, has died in France of wounds received in action.

Private A. K. Dorrity, Liverpool Scottish, who has fallen in action, enlisted in October, 1915, whilst engaged as an electrical engineer with Messrs. Campbell & Isherwood, Liverpool.

Air-Mechanic Bruce Andrews, R.F.C., who joined up five weeks ago, whilst at Rugby with the B.T.H. Co., has died from pneumonia following an attack of measles.

Second-Lieutenant E. L. Wood, Gordon Highlanders, who is wounded in a hospital near Manchester, was an engineer at the Arbroath electricity works.

Private Horace Grant, who was previously employed as a costs clerk by the Leeds City Tramways Committee, has been severely wounded.

Sergeant Jim Gavins, who has just been awarded the Military Medal for gallantry in the field, was a Leeds tramway inspector.

Lance-Corporal Norman Marsden, King's Own Scottish Borderers, who has been seriously wounded, served his apprenticeship with Mr. J. T. Foggo, electrician, of Dewsbury, just before the war.

Obituary.—Alderman Isidor Frankenburg.—We regret to record the death, which occurred on Saturday last, of Mr. Isidor Frankenburg, chairman of Frankenburg & Sons, Ltd., india-rubber and electrical cable manufacturers, Greengate, Salford. Alderman Frankenburg, who was 70 years of age, had been thrice Mayor of Salford, and he had been prominently associated with public welfare schemes at Salford from the time of his joining the Borough Council in 1897.

Herr Gustave Klein.—We read in the *Motor* that a report has been circulated that Herr Gustave Klein, late manager of the Bosch Magneto Works at Stuttgart, has been killed at the Front. "Klein may be regarded as the moving spirit of the marvellous Bosch organisation, and it was he who was responsible for the Bosch premises in Tottenham Court Road, finished just before the war broke out."

NEW COMPANIES REGISTERED.

Thames Electric Co., Ltd. (147,375).—Private company. Registered May 3rd. Capital, £250 in 5s. shares. To take over the business of an electrical and illuminating engineer, and wholesale and retail vendor of electrical and scientific goods and accessories carried on by F. P. Sexton, at 48, London Road, Kingston-on-Thames, as the Thames Electric Co. The subscribers (each with one share) are: F. M. Sexton, Warwick Lodge, Hampton Wick, Kingston-on-Thames, civil servant; F. P. Sexton, Warwick Lodge, Hampton Wick, Kingston-on-Thames, electrician. The first directors are F. M. Sexton and F. P. Sexton. Registered office: 48, London Road, Kingston-on-Thames.

Express Lift Co., Ltd. (147,366).—Private company. Registered May 3rd. Capital, £10,000 in £1 shares. Manufacturers of and dealers in hydraulic, electric, and steam elevators and lifts, &c. The subscribers (each with one share) are: F. Samuelson, 71a, Queen Victoria Street, E.C., solicitor; R. C. McC. Poulter, 71a, Queen Victoria Street, E.C., solicitor. The first directors are: E. W. J. West and J. A. Phelps. Registered office: 17, Victoria Street, S.W.

British & Allied Electrical Agency, Ltd. (147,350).—Private company. Registered May 2nd. Capital, £1,000 in £1 shares. To carry on the business of electrical engineers and contractors, manufacturers of and dealers in railway, tramway, telephone, and other apparatus, &c. Agreement with F. W. Dennis and A. W. Pollock. The subscribers (each with one share) are: A. W. Pollock, 5-6, Palace Chambers, Bridge Street, Westminster, electrical engineer; St. John Bennett, 16, Devonshire Square, E.C., incorporated accountant. The first directors are A. W. Pollock (permanent managing director and chairman) and F. W. Dennis. Registered office: 5-6, Palace Chambers, Bridge Street, Westminster, S.W.

Leon Cornelis, Ltd. (147,354).—Private company. Registered May 2nd. Capital, £1,000 in £1 shares. To take over the business of a manufacturer of electrical appliances and accessories carried on by L. Cornelis, of 5, Newcastle Place, Clerkenwell. Agreement with A. R. Robert. The subscribers (each with one share) are: L. Cornelis, 5, Newcastle Place, Clerkenwell, manufacturer of electrical accessories; A. R. Robert, 265, Strand, W.C. 2, company director; Captain C. L. Robert, 265, Strand, W.C. 2. The first directors are L. Cornelis and A. R. Robert. Registered office: 265, Strand, W.C. 2.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sun Electrical Co., Ltd.—A memorandum of satisfaction to the extent of £275 on April 28th, 1917, of debenture stock dated March 31st, 1911, securing £7,000, has been filed.

Enfield Electric Cable Manufacturing Co., Ltd.—A memorandum of satisfaction in full on April 17th, 1917, of mortgage, and further charges dated 1914, 1915, and 1916, securing £15,000, £11,250, and £2,750, has been filed.

British L. M. Ericsson Manufacturing Co., Ltd. (79,061).—Capital, £200,000 in 99,990 pref. and 100,010 ord. shares of £1 each. Return dated March 28th, 1917. All shares taken up. £1 per share called up on 50,010 ord., 8s. on 50,000 ord., and £1 on 99,990 pref.; £170,000 paid; £30,000 (12s. per share) considered as paid on 50,000 ord. Mortgages and charges: £50,000.

Johnson & Phillips, Ltd.—Land registry charge on freehold property at Charlton, dated March 23rd, 1917, to collaterally secure £102,948 (part of £175,000 owing to London General Investment Trust, Ltd.).

Altrincham Electrical Supply, Ltd.—Issue on April 30th, 1917, of £5,000 debentures, part of a series of which particulars have already been filed.

Montreal Tramways & Power Co., Ltd.—Particulars of £1,202,054 (5,850,000 dols.) gold notes created March 30th, and secured by trust deed dated April 2nd, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,099,315 (5,350,000 dols.). Property charged: (*a*) 6,000,000 and (*sic*) 5 per cent. mortgage debenture stock of Montreal Tramways Co., (*b*) 16,000 fully-paid common shares of 100 dols. each of said company, and (*c*) 5,333 similar shares, 10 per cent. paid. Trustees: Guaranty Trust Co. of New York.

CITY NOTES.

Bombay Electric Supply and Tramways Co., Ltd.

The report for 1916 states that the total revenue from all sources, including the amount represented by sale of current to the tramways, amounted to £373,467, an increase of £62,697, or 20.17 per cent. The total expenditure amounted to £156,688, an increase of £14,597, or 10.27 per cent. The net receipts from the year's working aggregated £216,779, an increase of £48,100, or 28.52 per cent. over those for the previous year. After deducting debenture interest, depreciation, &c., there remains £114,373, and £9,602 was brought in, making £123,976. The directors now recommend a dividend for the year on ordinary shares at the rate of 10 per cent. per annum. They propose writing down securities to the extent of £6,666, and to pay a bonus of one month's pay to the company's officers and employés, leaving £5,214 to be carried forward. The gross receipts from the traction branch amounted to £198,765, against £172,051, an increase of 15.53 per cent. The working expenses amounted to £87,826, against £79,665, an increase of 10.24 per cent. The balance of receipts over expenses in respect of the year's working amounted to £110,939, against £92,387 for the previous year, an increase of 20.08 per cent. The gross receipts of the supply department, including the amount represented by sale of current to the tramways, amounted to £171,167, against £138,021. The working expenses amounted to £62,293, against £58,132. The net receipts aggregated £108,874, an advance of 36.28 per cent.—*Financial Times.*

Cork Electric Tramways and Lighting Co., Ltd.

The revenue for 1916 was £67,011, and the expenses were £47,770, leaving £19,241, plus £4,041 brought forward, less £4,600 interest on debentures. After paying the preference dividend, putting £6,500 to reserve for depreciation and renewals, writing £1,534 off wiring consumers' premises, &c., and £569 off investments, £3,915 is to be carried forward. Lighting and power business continues to show progress, the year's additional connections totalling 557 KW., against 405 KW. for 1915. The revenue for the year increased by £3,106, lighting and power being up by £2,480, traction by £661, and other items down by £35. The expenses increased by £5,354, largely due to operating under war conditions (coal prices, war bonuses, &c.). The net revenue shows a still further reduction, and a dividend on the ordinary shares cannot be recommended because it is desirable to carry forward a larger sum than usual to provide against still further increase in the price of coal and other materials during the current year, and the carrying out of repairs to rolling stock, &c. which could not be executed owing to lack of skilled labour and difficulty in obtaining materials. The lighting and power tariff was again raised on July 1st, but the additions represent a very small percentage of the increased cost of operating. Capital expenditure during the year was £11,668, for the Curtis turbine and generating plant, house services, and cables. The 1,250-KW. Curtis turbine mentioned in the previous report was put into commission in September, and has already effected substantial economy in coal consumption.

Indian Electric Supply and Traction Co., Ltd.

At the annual meeting in London, on May 4th, the Chairman said that the year's results were very creditable to all concerned, and testified to the ability and energy of the staff in Cawnpore. The new capital expenditure of £8,919 on additions to generating station, car-shed and mains, was chiefly in connection with the municipal electric lighting and mills, which absorbed some 80 per cent. of the figure, and the balance represented extensions to power house and machinery, including £2,000, cost of new boiler now working. There had been difficulties in getting deliveries of coal, although they were among those who came in Class "A" for supply as an essential undertaking. One of the ways in which they felt the inability to get the coal delivered under their contract was that they had to make up with coal of an inferior quality, but in spite of this the (generating) cost per unit sold had fallen from .41d. to .36d. The net revenue account showed

marked improvement, the total for 1916 being £20,220, as against £15,932, the expenses, including debenture interest, £6,311 for 1916, as against £5,588. The number of units sold had increased by 478,418, and the revenue had risen Rs. 67,598, or about 21 per cent., and the average price realised had risen from 1.82d. to 1.87d. per unit. The total connections were 82,701 8-c.p. lamps, against 72,607 in 1915. The cost previously stated was slightly lower at .71d. against .73d. The position of the tramways remained practically unaltered; that was to say, the improved earnings were offset by higher costs. The increase in the passengers carried of some 300,000 was no doubt due to the improved earnings of the labour classes. In addition to prohibitive cost of all plant and material, they had great difficulty in arranging shipments to India, but in spite of this they had been able to dispatch a 500-kw. turbine, which they hoped very shortly to learn had arrived safely. They were forced to adopt the policy of waiting until after the war for any serious attempt to extend or widen the business. They looked forward with confidence to the future. In proposing the re-election of Mr. K. A. Scott-Monerieff as director of the company, the chairman said that a committee had been formed to represent companies such as theirs, registered in London, and operating in India, and Mr. Scott-Moncrieff had been appointed the first chairman.

River Plate Electricity Co., Ltd.

At the annual meeting, held on April 30th, Mr. Mattinson, K.C., who presided, said that the progress made by the company was gratifying, the balance before deducting depreciation being £5,878 better than for 1915. The increase in profit was due partly to the growth of business, but mainly to the economy with which the up-to-date plant enabled them to handle it. Last year he remarked that the dominant factor in the running of an electric power company anywhere, especially in South America, was the price of fuel. In South America the local supply of fuel, whether coal or oil, was almost negligible, and in these times of enormous shipping freights they could readily imagine that the cost of imported fuel was very great. Last year he spoke of coal being £5 to £6 in Buenos Aires, but to-day he had to speak of even higher prices. Coal was £7 in Buenos Aires, and oil bore its relation to this price. Profit in the running of an electric station would not be possible at these prices. The results of the company were to be largely attributed to the fact that during the past year they had had the benefit of a favourable oil contract entered into before the prices mentioned prevailed. That contract would also run throughout 1917, but, although so far this was reassuring, circumstances had now arisen which would make their fuel position in the current year much less favourable than in the past year. In the first place, the Argentine Government—pressed like every other Government for money—had imposed an import duty upon oil which fell upon them; in the second place, the source of their oil supply was the United States, and with the United States an actual participator in the war new complications had arisen which would further materially enhance their contract price. They must therefore be prepared for a substantial addition to their fuel cost during the present year. But what about fuel in 1918? It was necessary in such a business—where they had large bulk contracts, which must be carried out whatever the cost, like the supply for the public lighting of La Plata, and the tramway system of La Plata, and Armours' great packing establishment at Ensenada—to look ahead and, if possible, contract a year ahead. The war might or might not be still in progress in 1918, but no man of common prudence was justified in committing himself to any serious business proposition on the basis of peace being established before 1918. Moreover, he could not help thinking that so serious was the shortage of tonnage, and so great was likely to be the demand upon it in the period immediately after the close of hostilities, that the year 1918, at any rate the first part of it, was not likely to bring any amelioration of prices. That was the view which prevailed in business circles, and they were only able some months ago to renew their fuel contract for 1918 upon terms substantially in advance of the existing contract. Since then there had been a further great advance, and at the present time they could not contract for 1918 at anything like the prices obtained. As they would see this year, and still more in the following year, they would have to meet enhanced costs of working which would be reflected in the net profits. Their interest in the Tucuman Tramway, Light & Power Co. was limited to debentures. That company had fallen upon evil days. They were making a special allocation of £8,000 towards possible depreciation of investments, and when he reminded them that the war had caused for three years a suspension of all interest payments and amortisation upon their large holding in the German Trans-Oceanic Electric Co., and that no human being could be certain how the war would leave anything, he did not suppose anyone would question the wisdom of this precautionary measure.

Oriental Telephone & Electric Co., Ltd.

The gross earnings for 1916, including dividends and interest from subsidiary companies, amounted to £133,991, plus £2,344 fees received from subsidiary companies and £15,467 brought forward. The working expenses, maintenance, &c., were £44,493, depreciation of securities £250, interim dividends, debenture interest, and redemption charges £18,306. After paying the final preference dividend, and a final dividend of 6 per cent, tax free, on the ordinary shares, making 10 per cent. for the year, £55,000 is to be transferred to general reserve account, £2,000 to the staff pension fund, and £19,494 is to be carried forward. All the company's exchanges and those of the subsidiary companies continue to show improved revenues. The underground cabling extensions at Madras and Singapore have been completed. The Singapore exchange was destroyed by fire on December 9th, 1916. As a result of prompt measures to establish temporary communication, the number of exchange lines working on February 3rd was 700 out of a total of 1,850, and it was expected that the whole of the subscribers' service would be resumed by April 30th. The exchange is to be reconstructed in accordance with the most modern practice, but owing to the prevailing trade conditions there will be delay in manufacturing and installing the necessary equipment. The Indian companies again report a substantial increase in the number of subscribers to their exchanges, with correspondingly improved revenues. The Bombay Co. has paid 12 per cent. on shares of Rs. 50 each, as against 20 per cent. on shares of Rs. 25 each. The Bengal Co. has paid 7 per cent., as in 1915. The Telephone Co. of Egypt, Ltd., and the China and Japan Telephone & Electric Co., Ltd., have both paid 10 per cent., as before. Sir H. Babington Smith has joined the board as chairman in place of the late Sir George Franklin. Annual meeting: May 16th.

Brush Electrical Engineering Co., Ltd.

The annual meeting was held on Monday at 1, Kingsway, Mr. E. Garcke presiding. He said that the gross profits were £68,840, compared with £61,356 in 1915. The general charges showed a small increase. They had put £8,000 to depreciation, the same as in 1915, they placed £7,054 to reserve, compared with £5,000, and they had a net balance of undivided profits of £13,856, compared with £9,321 brought in. At a former meeting of the company the shareholders agreed with the suggested policy of not commencing the payment of dividends on the share capital during war-time, and they were, therefore, allowing the undivided balance to accumulate. As a matter of fact, the money could not be spared for distribution as dividend, for they had during the past three years expended £41,141 on additional plant and buildings without any increase of capital in the form of either debentures or shares. It was suggested two years ago that they should make a further issue, and the consent of the Treasury was obtained to such issue being made, but they had thought it better policy to utilise their undistributed profits and other resources instead of increasing the capital. The stock account in respect of goods in hand and in process of manufacture stood at £182,000, an increase of about £72,000, due to the greater volume of work on hand. The debentures were gradually being reduced by the operation of sinking funds. General reserve stood at £20,000, compared with £9,358, and the amount owing to creditors and on loan account showed a reduction of about £15,000. Altogether, therefore, the profit and loss account and the balance sheet for the past year showed improvement in most of the items. The effect of the Munitions Act and Excess Profits taxation in respect of the year 1916 was still uncertain, and for this reason also the amount carried forward must be ample. It was a matter for regret, he ventured to think, not only from a particular point of view, but on national grounds, that the Chancellor of the Exchequer had found it necessary to increase the excess profits tax from 60 per cent. to 80 per cent. No one was in favour of large and exceptional profits being earned by individuals or by companies by reason of war activities, and all excess profits of this character rightly accrued to the community. Moreover, it was recognised by everyone that the great cost of conducting this unparalleled war to a successful issue must involve heavy taxation all round; but it was also evident that after the war the nation would be badly in need of reproductive capital, not only to replace the accumulated capital which was unavoidably destroyed by the war, but also to provide for expansion of industry. The President of the Board of Trade had told them that an employer should not be satisfied with carrying his business to a certain point of expansion—that there could be no standing still in business; that they must go forward. Every man, he said, who was interested in a great business had to make that business as big as conditions would permit. This could not be done without the constant renewal and increase of capital. Practically the only source of new capital was the surplus provided by production in excess of consumption, and to take that surplus at the source by way of taxation to the extent of destroying the fund out of which future capital was obtained was like eating the seed and foregoing the fruit. It might appear presumptuous to give expression to these opinions in view of the statement of the Chancellor of the Exchequer that it was better to take the money in the form of excess profits duty than to add to the income tax, but he was not alone in being sceptical as to the correctness of this economic policy. The President of the Association of Chambers of Commerce had expressed the view that our Government was at present squeezing the reserves out of the producers that they ought to have

available for business after the war. If this policy was continued, he said, the responsibility for unemployment must rest upon the Government, and not upon the manufacturers. American manufacturers had been able to accumulate enormous reserves in their businesses; the German Government had deliberately abstained from an excess profits tax in order to leave their industries in the strongest possible position after the war. He (Mr. Garcke) feared that at the present time, when the indispensability of labour was being so strongly impressed upon them, they were apt to forget that capital was equally necessary, and, what was more, that labour could not be employed without it. That there would be a large demand after the war for new work and more commodities was undoubted, and that there would be abundant labour and willingness to work was also evidenced, but were they quite sure that they would have the other resources necessary for production? That was a big economic question which could not be too fully discussed. Every man who was, or had been, in business knew that he could not convert a little business into a big business without capital, and he knew, too, the difficulties of raising that capital, and yet when they discussed that question in its large national aspects they frequently spoke and acted as if capital were unlimited. The orders secured during 1916 were satisfactory in volume, and the same could be said of the order list as it stood to-day. During the past year the whole resources of their establishment had been engaged. In the engineering shops their production had been very much on the usual lines, owing to the great demand for generating plant, motors, transformers, and other apparatus. In their rolling stock department, the character of the work had entirely changed from pre-war standards. The urgent demand for other work, coupled with the difficulties of shipping, had brought their ordinary industrial and export business to a standstill, but, wherever possible, they were arranging with their customers to allow their orders of this class to go on a waiting list, to be dealt with as soon as circumstances permitted. At previous meetings he had spoken of the success of the Ljungström turbine, and confirmatory evidence was available to-day Notwithstanding the present very unusual conditions, they had a larger number of orders for turbines of this type on hand than ever before, and there were many others in prospect as soon as the position became more normal. The female labour at the Loughborough works now represented a very considerable proportion of the total. There was one aspect of the labour question to which he would like to refer. They were familiar with the demands for higher wages made by all classes of employés in order to accommodate themselves to the increased cost of living, and he would be the last to suggest that such increases, by way of war bonuses, were not necessary, or had not in every way been deserved. Latterly, however, the Government, in order to expedite a settlement of such demands, had made direct awards bringing the advances granted into practically immediate operation. Now, in cases, like their own, where firms were engaged on contracts at fixed prices, which ran into large sums of money, and often took many months to complete, it might, he thought, not be unreasonable to expect that such Government awards should be accompanied by regulations for the purpose of automatically reimbursing manufacturers for the increased cost they were put to in respect of contracts which were unfinished at the time the increased wages became payable. That, unfortunately, was not the case; and although manufacturers might be able in some instances to obtain an advance on their contract prices, that was always a matter of difficulty, and there must be many cases where, so far as unfinished work was concerned, the bonus paid to employés came out of the manufacturers' small margin, and not out of increased prices. That was a matter which, he submitted, should be well considered by the Government departments concerned in dealing with similar applications in future.

Mr. B. S. Broadhurst seconded the motion.

Replying to Mr. Marchmont, the Chairman said they were all big shareholders in the company, and would like a dividend, but it would be a very uneconomical thing at the present juncture to make any distribution. They must have a little more patience, and wait until after the war, when conditions might enable them to pay and maintain a moderate dividend.

General Electric Co. (U.S.A.).

The report of this company for 1916 shows that the extraordinary demand for its various products made it necessary to operate its manufacturing and other facilities to the limit of their capacity. The value of orders for electrical machinery and supplies was $167,169,000, or 70 per cent. more than in 1915, and 50 per cent. more than the corresponding orders for the largest previous year, 1913. The orders for special war munitions received during the year, amounting to $2,416,000, were merely supplementary to previous contracts. The sales billed amounted to $134,242,290, and the net result was a profit of $15,294,091, plus $3,866,882 income from other sources. Interest on debenture bonds absorbed $571,445, and dividends (8 per cent.) on stock $8,121,546, leaving $10,467,882 carried to surplus. The number of employés in factories and offices of the company and its subsidiaries was 79,000 at the end of 1916. The company followed its customary practice in writing off against income its total expenditures during 1916 for patents, applications for and licences under patents, and other outlays relating thereto, amounting to $891,880. The patent account is carried at $1.00, as in previous years. The increase in merchandise inventories was due not only to the greater volume of business, but to the necessity for carrying, at the existing high prices, larger than normal stocks of all kinds of material as a safeguard against uncertainties of delivery. Urgent pressure upon the management for immediate and extensive additions to the manufacturing facilities involved the expenditure of $8,828,255 for plant account during 1916. "This outlay, as compared with ordinary costs, was abnormal and excessive, in view of which it has seemed wise to write off against income an amount substantially equal to the year's disbursement. The cost of all the special tools, jigs, dies, drawings, and patterns was thus disposed of, and also the greater part of the cost of the large machine tools and apparatus. Advantage was taken of the opportunity to reduce the book value of building accessories, such as piping, wiring, &c., covering additions for a period of years, which will explain the fact that the amount written off for 'real estate and buildings' was larger than the expenditure thereon for the year." The total capital stock issued is $101,512,500.

Babcock and Wilcox, Ltd.

The net profit for 1916 was £438,323, plus £42,125 brought forward. After paying the dividend on the 6 per cent. and 5 per cent. preference shares, from which income-tax is to be deducted, and 15 per cent. (free of tax) on the ordinary shares, there is placed to reserve £150,000, and to staff pension fund £10,000, leaving £56,495 to be carried forward. The increase in reserves for estimated further expenditure on orders invoiced is required because of the greater cost of materials and labour, &c., which affect the completion of contracts taken into the accounts. A larger reserve for fall in value of investments is also necessary, owing to the diminution in value to which trustee investments have been subject. The company's investments in War Loan have been, by conversion and additional subscription, increased to £520,000 nominal of the new 5 per cent. War Stock. In view of the prevailing increased rate of income-tax and the directors' desire to pay the ordinary dividend free of income-tax, as has hitherto been the custom, the shareholders are in reality receiving the equivalent of an increased rate of dividend.

Austrian Companies.

The Kabel Fabrik A.G., of Pressburg, reports net profits of £38,000 for 1916, as compared with £29,000 in the previous year. The directors recommend the payment of a dividend of 15 per cent., as contrasted with 11 per cent. in 1915.

The Felten & Guilleaume Kabel, Draht und Drahtseil Fabrik, of Budapest, reports net profits of £30,000 for 1916, as compared with £20,000 in the previous year. It is intended to pay a dividend at the rate of 15 per cent., as compared with 12½ per cent. in 1915, on share capital of £83,000.

The A.E.G.-Union Elektrizitats Gesellschaft, of Vienna, after apportioning £19,000 to depreciation in 1916, as against £17,000 in the previous year, reports net profits amounting to £75,000, as compared with £46,000. It is proposed to distribute 8 per cent., as contrasted with 6 per cent. in 1915.

The Elektrizitats A.G. vorm. Kolben & Co., of Prague, reports gross profits amounting to £169,000 for 1916, as compared with £136,000 in the previous year. After meeting general expenses and making provision for depreciation, the accounts indicate net profits and balance forward of £72,000, as contrasted with £69,000 in 1915, the rate of dividend being 9½ per cent., as against 9 per cent. in the preceding year.

The report of the *Felten & Guilleaume Co., of Vienna,* states that the value and volume of the turnover in 1916 were almost twice those in the preceding year, the strenuous activity rendering necessary substantially greater provision for depreciation than in 1915. After allocating £36,000 to this purpose in 1916, as against £18,000, the accounts show net profits amounting to £153,000, as compared with £105,000. It is proposed to pay a dividend of 20 per cent., this contrasting with a rate of 12½ per cent. in 1915, on ordinary share capital of £354,000.

The Neuhausen Aluminium Co.—The report for 1916 of the Aluminium Industries A.G., of Neuhausen, whose financial results were recently published, states that it was possible to keep the works very active and in uninterrupted operation, as in the previous year. As a result of great exertions, the works were supplied with raw materials for a certain time, and sale conditions were favourable. The installations at Neuhausen and Rheinfelden remained without change, whilst those at Lend-Lauris experienced an unimportant expansion. In the case of the Vallais works, a fresh expenditure of £177,000 was incurred, chiefly for the extension of the Chippis Aluminium Works, and for the completion of the hydro-electric works on the Borgne. The installations in France were unchanged; the sequestration was sustained, and the company was only permitted to provide money for the maintenance of the mining concessions. Of the auxiliary companies which served for the production of alumina only, the Goldschmieden-Trotha Co. showed an increase in expenditure. The Martinswerk was largely extended, and the Hungarian Bauxite Co. worked satisfactorily.

British Ever-Ready Co., Ltd.—For the year ended March 31st, 1917, the amount available for appropriation, after writing off depreciation, payment of Excess Profits Tax for 1914-15 and 1915-16, and after making reserve for Excess Profits Tax for 1916-17, is £28,656. After paying 10 per cent. on the preference shares, and 10 per cent. and a bonus of 5 per cent. on the ordinary, £2,906 is to be carried forward. The amount of Excess Profits Tax payable for 1914-15 and 1915-16 was higher than was anticipated at the last meeting, owing to the tax having been raised by the Finance Act, 1916, from 50 per cent. to 60 per cent. for the latter year. This increase represents approximately £4,000. The full amount of the tax for these two years has been paid. Provision has been made for Excess Profits taxation for the past year, which, but for the high rate of taxation, would have been a most successful one. The directors consider the above distribution satisfactory having regard to the increased taxation. Annual meeting: June 1st.

Midland Electric Corpn. for Power Distribution, Ltd.—The report for 1916 states that the balance to the credit of the net revenue account, after payment of debenture interest, is £33,182, plus £8,932 brought forward, making £42,115. Out of this the directors recommend a dividend of 5 per cent. on 30,000 ordinary shares, leaving £11,802 to be carried forward, subject to excess profits tax. The net capital expenditure in respect of plant, mains, transformers, &c., was £36,916. To provide for this outlay debenture stock to a total nominal value of £45,600 was sold. The increasing demand for power continued to such an extent that it became necessary to again order additional plant. Accordingly a contract was placed for a new generating set of 3,000-KW. capacity, and the erection completed at the end of December last. Since that date still further applications for supply have been received, amounting to several thousands of horse-power, which the company is, unfortunately, unable to accept at present.

Bath Electric Tramways, Ltd.—Mr. J. B. HAMILTON presided at the annual meeting recently. He said it was refreshing to find that at Bath the cost of tramway travelling had not been disturbed, notwithstanding that the cost of practically everything that one had to buy had been increased by 50 to 100 per cent. At the present time, however, many tramway undertakings were seriously considering their position, and it might become necessary to ask the Board of Trade, in consideration of the extraordinary state of affairs, to authorise rates of fares in excess of those which their statutory powers allowed to be charged. Notwithstanding many adverse conditions, the traffic and other receipts were up £1,157. Mr. A. A. C. SWINTON seconded the adoption of the report.

Craigpark Electric Cable Co., Ltd.—The net profit for the year ended March 31st, 1917, was £7,966, after making provision for excess profits tax, plus £900 brought forward. It is proposed to put £2,000 to depreciation of buildings and machinery; £500 to reserve; to pay the 6 per cent. preference dividend, and 6 per cent. on the ordinary shares, carrying forward (subject to directors' fees) £1,266. The volume of business done was satisfactory, although production had been handicapped by shortage of labour and scarcity of raw materials. Annual meeting: Glasgow, May 10th.

West India & Panama Telegraph Co., Ltd.—The report for last half of 1916 states that the amount to credit of revenue is £49,118, as compared with £33,553 in the corresponding half-year of 1915, and the expenses have been £32,189, against £22,987. The directors have placed £4,000 to reserve, and it is proposed to pay on the ordinary shares 6d. per share (free of income-tax), leaving a balance of £2,888. The traffic receipts show an increase, due to prices of produce being favourable to the planters.

Brisbane City Electric Light Co., Ltd.—The credit balance for the year ended January 31st, 1917, was £25,711. The interim dividend and dividend duty paid in September, 1916, absorbed £10,884, and a further 3 per cent. on the preference, and 5 per cent. on the ordinary shares, together with dividend duty and an allowance for Federal income-tax, will absorb £14,279, leaving £2,117 to be carried forward.

Clevedon, Portishead & District Electric Supply Co., Ltd.—The annual meeting was held recently. In spite of very difficult conditions, the gross revenue was more than double that of the previous year. The receipts were £3,955, against £1,737 last year. Notwithstanding the increased cost of fuel, &c., the gross profit was £884, compared with £696.

Oriental Telephone & Electric Co., Ltd.—It is proposed to pay 6 per cent. per annum on the preference shares for the half-year ended December 31st last, less income-tax, also a final dividend of 6 per cent. on the ordinary shares, free of income-tax, making a total of 10 per cent. for the year. The annual meeting is called for May 16th.

Melbourne Electric Supply Co., Ltd.—Interim dividend on the consolidated ordinary stock at the rate of 10 per cent. per annum, free of income-tax, for the half-year ended February 28th.

Calcutta Tramways Co., Ltd.—Final dividend on the ordinary shares of 6s. 6d. per share, less tax, or 5s. 6d. per share net, making 9½ per cent. for 1916.

Shanghai Electric Construction Co., Ltd.—A dividend of 5 per cent. is announced, making 10 per cent. for 1916.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK Exchange markets and business are on the quiet side. Prices hold their own with a good deal of steadiness, but two factors combine to restrain the investor from opening his purse-strings. One of these is the situation in Russia; the other is the submarine activity. Neither is regarded as an obstacle that will not be overcome sooner or later; but, for the time being, they plant restraint in Stock Exchange allotments, and there are comparatively few changes of moment on the week.

The principal movements are again in the Mexican group. While there has been nothing fresh up to the present to add to expectations that Mexico will come into the war on the side of the Allies this week, inquirers are bidding for bonds which holders do not care to part with. Therefore, we have the anomaly of Mexico Tramways 5 per cent. first mortgage bonds standing at 37½, although the last bargain marked in the Stock Exchange Official List was at 24¾; and the 6 per cent. mortgage bonds, quoted at 27½, were last dealt in at 23¼. Mexican Light & Power Firsts, now standing at 37½, marked 29¼ a few days ago. The company's common and preferred shares stand at 13½ and 22½ respectively. Monterey debenture stock and Pachuca 5 per cent. first mortgage bonds have both been advanced without any stock changing hands of late.

Other foreign bonds are mostly firm. Brazilian Tractions have been erratic, rising to 46½ before they eased off a little, the reaction coming about in consequence of a slight weakening in the exchange. Melbourne Electric consolidated ordinary stock, which has been standing at 156 since the middle of February, gave way to 147½ on a slight pressure to sell; stock changed hands at 145, which is 47 points lower than the middle price at the outbreak of war.

The Argentine group of tramway stocks keeps fairly steady; and attention is being drawn to the 5 per cent. debenture, with interest payable on June 1st and December 1st, the yield being a trifle over 7¼ per cent. on the money, without making allowance for the five months' accrued dividend. Of its kind, the stock looks a very fair investment.

The British Columbia Electric Railway sextet is depressed, in consequence of the impression that competition is going to be set up in Vancouver. Whether this materialises or not remains to be seen, but a scheme is on foot to this end, though we understand that it is meeting with considerable opposition from holders of the British Columbia Electric Railway stocks.

Para Electric Railways ordinary are rather firmer at 3¼, and the preference at 4¼, these having sympathised with the decidedly better tone for Brazilian issues generally, which has been a feature in the Stock Exchange during the past fortnight.

The telegraph list is unusually devoid of change. Indo-Europeans are just below 50 again, and New York Telephone bonds, now ex dividend, stand at 99. Chili Telephones eased off to 6 15/16; while amongst cable shares, apart from Indo-Europeans, no alterations at all have occurred. Direct United States Cable shares are a shade better at 6. Eastern Telegraph preference changed hands last Friday at 62. West India and Panama ordinary have been done as low as 18s. 6d.; but business in the list as a whole has been far to seek. Marconis show 1/16 fall; Americans, after drooping to 14s. 6d., recovered to 15s. bid.

The catalogue of home electricity shares is also colourless as regards changes. Apart from Cities and Counties, there is little going on amongst the London shares. Urban 5 per cent. preference were dealt in two or three days ago at 37s. 6d., and the ordinary shares are quoted at 3s. 6d. Victoria Falls preference are a little better at 21s. 9d. Edmundson's remain at 3s. 9d. for the ordinary, 50s. for the preference, and 10s. for the non-cumulative preference. The four Brush Electric stocks are quoted at 25 for the ordinary, and 79, 60, and 52 for the three debenture stocks in their order of priority. Manufacturing shares as a whole are as quiet as those of the supply companies. British Aluminium 5 per cent. debenture stock has risen 2 points to 88.

Babcock & Wilcox hardened 1/16 to 2 15/16 on the fine report, and manufacturing shares hold their prices firmly. In regard to controlled companies, the Chancellor of the Exchequer's announcement that excess profits duty is to be substituted for the munitions levy has aroused lively attention, and the general opinion in the Stock Exchange seems that the alteration will be all to the good of the companies. Several of the iron and steel shares are therefore better.

The rubber market gave way at first on discussion of the Budget's intention to raise the excess profits duty from 60 per cent. to 80 per cent., though recovery followed in most cases. Business, however, runs on quiet lines; and the same remark will cover Stock Exchange markets with scarcely an exception.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price May 8, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6¼	—	£6 18 6
Charing Cross Ordinary	5	5	3⅝	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	2½	—	6 18 6
Chelsea	4	3	2⅞	—	5 4 4
City of London	8	8	11⅜	—	6 17 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 16 6
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8½	—	5 6 8
Metropolitan	8	8	2½	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	8	8	6½	—	6 8 0
South London	5	5	2⅞	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅜	—	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	95	—	6 6 2
do. Def.	33/6	1½	22½	—	6 13 4
Chile Telephone	8	8	6⅞	— 1/16	5 15 4
Cuba Sub. Ord.	6	5	8½	—	5 17 8
Eastern Extension	8	8	14	—	*5 14 4
Eastern Tel. Ord.	8	8	141½	—	*5 13 1
Globe Tel. and T. Ord.	7	7	12½	—	*5 14 8
do. Pref.	6	6	10	—	6 0 0
Great Northern Tel.	22	22	88	—	5 15 9
Indo-European	13	13	49½	— 1 1/16	6 11 4
Marconi	10	10	21⅞	—	8 11 2
New York Tel. 4½	4½	4½	99 xd	—	4 11 0
Oriental Telephone Ord.	10	10	2½	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 0 9
West India and Pan.	6d.	6d.	1	—	2 10 0
Western Telegraph	8	8	14	—	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	60¼	—	6 8 0
Metropolitan	1	1	23⅞	— ½	4 3 10
do. District	Nil	Nil	16	—	N l
Underground Electric Ordinary	Nil	Nil	1⅞	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	80½	— ½	*6 4 3
Foreign Trams, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	8¼	—	8 16 0
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	68½	—	7 6 0
Brazil Tractions	4	4	45½	+ ½	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	5	60	— 1	8 6 8
do. do. Preferred	—	Nil	44	— 2	Nil
do. do. Deferred	—	Nil	37½	— 2	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	37½	+4	Nil
do. 6 per cent. Bonds	—	Nil	27½	+ ½	Nil
Mexican Light Common	Nil	Nil	13½	+1	Nil
do. Pref.	Nil	Nil	2⅛	+5	Nil
do. 1st Bonds	Nil	Nil	37½	+4	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	21⅛	+ 1/16	5 2 6
British Aluminium Ord.	5	7	27/6	—	7 6 10
British Insulated Ord.	15	17½	123	—	6 17 3
British Westinghouse Pref.	7½	7½	2 5/16 xd	—	6 9 10
Callenders	15	20	18½	—	7 11 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	23	8⅝	—	6 18 0
Edison & Swan, £3 paid	Nil	—	1/16	—	Nil
do. do. fully paid	Nil	—	1/8	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	—	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9⅞	—	6 3 1
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	37	—	*6 9 10

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Bristol (Trams)	April 27	20,480	+ 9·6	..	78,243	+ 960	30·5	..
Cork	„ 26	1,986	+ 73	17	7,655	+ 12	9·89	..
Dublin	„ 27	24,598	+5,095	17	99,710	+ 4,221	54·25	..
Hastings	„ 29	4,162	+ 81	..	15,587	+ 2,216	19·3	..
Lancashire United	„ 25	8,593	+1,026	17	30,6 2	+ 2,961	42	..
Llandudno-Col. Bay	„ 27	1,107	— 324	21½	4,167	— 416	6·5	..
Anglo-Argentine	„ 29	307,502	+1,163	17	868,155	+ 1,806	..	..
Auckland	„ 6	21,178	+ 411	40	214,586	+ 8,882	26·29	..
Calcutta	„ 28	17,499	— 198	..	..	— 1,060	..	..
Kalgoorlie, W.A.	January	2,431	..	..	2,431	..	20.5	..
Madras	..	..	..	..	..	..	..	..
Montevideo	April	29,330	+ 238	26	186,622	— 797	..	..
Dublin-Lucan Rly.	April 26	580	+ 17	17	2,088	+ 64	7	..

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 9th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	„	£34	..
a Bisulphide of Carbon	„	£28	..
a Borax	„	£38	..
a Copper Sulphate	„	£61 10	..
a Potash, Chlorate	per lb.	2/6	..
a „ Perchlorate	„	2/-	..
a Shellac	per cwt.	215/-	10/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	„	£35	£3 inc.
a „ Lump	„	£20	£2 inc.
a Soda, Chlorate	per lb.	1/-	..
a „ Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c „ Tubes (solid drawn)	„	..	..
c „ Wire, basis	„	..	..
c Copper Tubes (solid drawn)	„	1/8½ to 1/9	½d. dec.
g „ Bars (best selected)	per ton	£165	£3 dec.
g „ Sheet	„	£165	£3 dec.
g „ Rod	„	£165	£3 dec.
d „ (Electrolytic) Bars	„	£142	£3 dec.
d „ „ Sheets	„	£167	£3 dec.
d „ „ Wire Rods	„	£150	£3 dec.
d „ „ H.C. Wire	per lb.	1/5½	1/16d. dec.
f Ebonite Rod	„	3/-	..
f „ Sheet	„	2/6	..
n German Silver Wire	„	2/3	..
h Gutta-percha, fine	„	6/10	..
h India-rubber, Para fine	„	3/0½	½d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l „ Wire, galv. No. 8, P.O. qual.	„	£10	..
g Lead, English Pig	„	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e „ „ „ medium	„	8/6 to 6/-	..
e „ „ „ large	„	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/9½	½d. dec.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	„	..	..
n „ Wire, Nos. 1 to 16	per lb.	3/6	3d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

London Chamber of Commerce.—At the annual meeting of the Chamber, on Wednesday, May 2nd, the following report of the Electrical Section was submitted :—

At the annual meeting, Mr. W. L. Madgen's resignation as chairman of the Section was received with much regret, as was also that of Mr. A. M. Sillar, deputy chairman, and a vote of thanks was passed to these gentlemen for their services. Mr. Stuart A. Russell was unanimously elected to the office of chairman, and it was decided that the position of deputy chairman should not be filled for the time being.

New Electricity Bill.—Consideration was given to a Bill introduced by the Incorporated Association of Municipal Engineers which would enable local authorities to open showrooms to sell fittings and wirings, and practically to carry on the business of ordinary electrical contractors, and the Section reaffirmed previous resolutions protesting against interference on the part of the municipal authorities with the business of making and selling fittings and wiring premises in competition with electrical contractors.

Trade After the War.—The Section considered the various reports of the Special Committee of the Chamber on Trade During and After the War, and a discussion took place as to the attitude of the Electrical Section on the question of proposed tariffs in connection with goods of enemy, allied and neutral nations. It was left to the discretion of the chairman to express the views of the electrical trade on this matter to the Special Committee on which he represented the Section.

Government Committees on British Trade.—In view of the appointment by the President of the Board of Trade of a Committee to consider the position of the electrical trade after the war, especially in regard to international competition, a communication was addressed to the Committee asking for some indication of the points upon which they would desire evidence, and the lines on which they proposed to conduct the inquiry. The Section being of opinion that it was desirable to offer evidence, a Special Committee was appointed to consider the evidence to be given, and two members were asked to prepare drafts of evidence, one on the legislative side of the question, and the other on the commercial, industrial, and international side. After further consideration, the member of the Committee appointed to give evidence on the legislative side of the question decided that such a course would be undesirable, and Mr. Stuart A. Russell, chairman, prepared a draft of evidence on the commercial, industrial, and international aspect, which was duly forwarded to the Government Committee, and acknowleged by the secretary, but up to the end of the year no appointment had been given for the evidence to be heard orally.

Electrical Exportations Committee.—The Section offered to assist the War Trade Department in furthering its efforts to prevent the export to enemy countries of those essential insulating materials which entered into the manufacture of electrical apparatus now so largely used in the manufacture of munitions of war. After a conference had taken place with representatives of the War Trade Department, the Admiralty, and the War Office, a Committee of members of the Electrical Section was appointed as an official Advisory Committee attached to the War Trade Department. Various kinds of material captured by the military and naval authorities have been submitted for examination, and reports have been forwarded to the War Trade Department.

HIGH-PRESSURE ELECTRIC RAILWAY SYSTEMS.

One of the most interesting electric traction developments within recent years has been the employment of high-tension direct current as utilised on the Bury to Manchester line of the Lancashire and Yorkshire Railway, and on the Shildon to Newport line of the North-Eastern Railway. The most remarkable high-pressure direct-current scheme is the Chicago, Milwaukee and St. Paul installation, which works at a pressure of 3,000 volts.

It is not so much the high pressure that makes the undertaking notable as the fact that the locomotives are larger than any other locomotives, steam or electric, hitherto built; and, furthermore, they are designed for regeneration. As a result of the high track pressure, the spacing of the sub-stations is wide, but the efficiency of the machines which these sub-stations contain must be appreciably lower than that of the converters usually adopted. Motor-generators composed of a synchronous motor coupled to two direct-current dynamos, permanently connected in series, are not, of course, so efficient as rotary converters. If rotaries could have been installed in the sub-stations, the overall efficiency of the system would have been improved, although the smaller number of sub-stations required, as the result of the high track pressure leads, of course, to economy in other directions. A 3,000-volt rotary has not, so far as the writer is aware, been built even for a 25-cycle circuit, and as the current for the Milwaukee and St. Paul system is taken from power stations built originally for general lighting and power supplies, the need for motor-generators in the sub-stations is scarcely to be wondered at.

Even on the Shildon to Newport lines of the North-Eastern Railway, where the track pressure is only 1,200 volts, each converter unit in the sub-stations consists of two 600-volt rotaries connected in series. On the Bury to Manchester lines of the Lancashire and Yorkshire Railway, however, where the pressure is 1,500 volts, each rotary is designed for the full working pressure. High-voltage rotaries are also running in America, apparently with success, but a 3,000-volt, 60-cycle rotary has still to be developed.

Another new system, equally attractive from a technical standpoint, is the "split-phase" system, as adopted on a section of the Norfolk and Western Railroad. In this case, single-phase current at a pressure of 11,000 volts is collected from a single overhead wire, but it is converted on the locomotives, by means of a phase converter, into three-phase current, which is supplied to the driving motors.

Like the direct-current motors on the Chicago, Milwaukee, and St. Paul Railway, those on the Norfolk and Western system are regenerative. The advantages of the "split-phase" system are that it possesses all the good points of the three-phase system and it only involves the use of one overhead wire. When regeneration is desired, the ordinary three-phase system is distinctly advantageous, because the motors will, when the rotor revolves slightly above the speed of the revolving field, return current to the line without the use of special arrangements on the locomotives. But in yards and at crossovers, the two conductors make the overhead equipment complicated, and pressures as high as those used on single-phase lines are not, as a rule, adopted.

On the Italian State Railways, the three-phase system has been adopted as standard, but the working pressure is only 3,000 volts. With a "split-phase" system, a pressure of 15,000 volts or more can be employed with the same ease and safety as with a single-phase system, and when the engines are descending gradients, the motors return current to the line through the phase converter. The latter, which resembles an induction motor so far as its general construction is concerned, does not introduce much additional complication or expense, and its use is amply justified by the fact that it enables three-phase current to be supplied to the driving motors whilst single-phase current is drawn from only one overhead conductor. For conditions such as those which are met with on the electrified lines of the Norfolk and Western system, where the gradients are severe and the trains hauled are heavy, the "split-phase" system is undoubtedly advantageous.

When regeneration is required, the single-phase system has little to recommend it. True regenerative single-phase locomotives have been designed and constructed, but they are distinctly inferior to locomotives equipped with three-phase motors. The most interesting tests which have been carried out with single-phase locomotives within recent years are probably those made on an experimental line of the Midi Railway in France. All kinds of single-phase motors were tried, and it was specified that the engines submitted for trial should be capable of regenerating when descending gradients. Some of the engines fulfilled these conditions, but, owing to the special exciting arrangements which had to be provided for making the motors act as generators, the engines were more complicated than others that have been built for service where regeneration is unnecessary. One firm that built a locomotive for this experimental line came to the conclusion, after many trials, that regeneration with single-phase current was too troublesome to warrant its adoption, and, instead of designing the locomotives to return current to the overhead conductor, the company's engineers fitted the engine with resistances to absorb the regenerated current.

It would be wrong to assert that single-phase motors cannot be made to regenerate, but it is certainly true that they do not lend themselves to it nearly so well as three-phase motors. Although single-phase motors have been considerably improved within recent years in some respects, they still remain, and will always remain, inferior to machines which work with direct and polyphase alternating current. An American engineer who is an ardent advocate of single-phase traction mentioned some time back, whilst describing some experiments with mercury vapour rectifiers, that on fitting one of these rectifiers to a single-phase locomotive the power of the engine was materially increased, which proves pretty clearly, if proof is needed, that a motor of given dimensions and weight will develop more power when supplied with direct current than when supplied with single-phase alternating current.

The difficulty of obtaining high-tension direct current for traction purposes from generators and converters is one of the obstacles in the way of the development of really high-pressure direct-current systems. If the revolving machinery at present utilised in sub-stations could be replaced by some form of static apparatus, such as mercury vapour rectifiers, commutation troubles would vanish and direct-current pressures considerably in excess of 3,000 volts might be applied to the track, provided, of course, that the motor and control equipments could be built to work at these pressures. The highest pressure that has been used on a direct-current railway is 5,000 volts. An experimental 5,000-volt line associated with the Michigan United Traction Co.'s system has now been working for some time without a breakdown in the insulation or any trouble due to the high voltage. The track, in this case, is not fed through rotary converters, but through mercury vapour rectifiers.

Hitherto, it has been customary in experiments of this kind, to place the rectifiers on locomotives, and to collect alternating current from the overhead wire; but in this case the rectifiers are placed in a sub-station, and high-pressure direct current is fed into the system. Whether this scheme will ever be practicable on a large scale, remains to be shown; but in any case, the scheme is, to say the least, extremely interesting. In some ways, a high-pressure direct current on an overhead wire is preferable to a high-pressure alternating current, especially when there are telegraph and telephone wires in close proximity; but whereas alternating-current pressures can be reduced with static transformers placed on locomotives and motor coaches, direct-current pressures can only be changed with revolving machines. But as motor equipments have been made to work satisfactorily on this short experimental 5,000-volt line, there is no very obvious reason why the system should not be developed on a larger and more elaborate scale.

AN APPROXIMATE FORMULA FOR MAGNET COILS.

[COMMUNICATED.]

ELECTRICIANS and engineers who only occasionally want to make approximate calculations, may find that the employment of the formula usually given in text-books is not infrequently a little inconvenient and unhandy. The writer finds a formula reduced to simple expressions for approximating readily the length of wire in, or the ohmic resistance, current, or ampere-turns of, shunt field coils can easily be obtained as follows :—

In a magnet coil, the approximate number of turns per layer per inch of length of winding is 1 ÷ dia. (inches) of wire, and the number of layers per inch of depth of winding is also 1 ÷ dia. of wire ; the number of turns per square inch of winding space is (1 ÷ dia. of wire)², and the number of turns for a given winding space is approximately

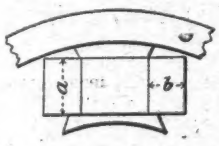

FIG 1.

equal to the area of winding space in square inches multiplied by (1 ÷ dia. of wire)².

The total length in feet of wire in a coil will, therefore, be :—Area of winding space × length of mean turn (feet) × (1 ÷ dia. of wire)².

The resistance of the coil will be :—Area of winding space × length of mean turn (feet) × resistance per foot × (1 ÷ dia. of wire)².

The current (amperes) in the coil will be :—Volts across coil ÷ (area of winding space × length mean turn (ft.) × resistance per ft. × (1 ÷ dia. of wire)²).

The ampere-turns will be :—Volts across coil ÷ (length of mean turn in ft. × resistance per ft.)

Formulæ derived from the above reasoning may be simply stated :—

$$\text{Length (ft.) of wire in coil} = A \times T \times L_k$$
$$\text{Resistance (ohms, cold)} = A \times T \times R_k$$
$$\text{Current (amps.)} = V \times C_k / A\,T,$$
$$\text{Ampere-turns} = V \times C\,T_k / T,$$

when— A = Area ($a \times b$) of winding space around magnet pole in square inches, as indicated in fig. 1.
T = Length of mean turn in inches,
V = Volts across coil, and
L_k, R_k, C_k, and $C\,T_k$ are constants.

Constants may easily be worked out for any size of wire ; values for Nos. 10 to 26 gauge D.C.C. wires are shown in the table below :—

Wire gauge No.	Dia. D.C.C.	L_k.	R_k.	C_k.	CT_k.
10	·14	4·25	·00266	378	19,100
11	·128	5·10	·0039	260	15,650
12	·116	6·2	·0059	170	12,600
13	·104	7·7	·0093	108	9,850
14	·090	10·3	·0166	60·5	7,450
15	·082	12·4	·0247	40·7	6,040
16	·074	15·2	·0380	26·3	4,775
17	·066	19·2	·0630	15·9	3,650
18	·058	24·70	·110	9·1	2,680
19	·050	33·30	·212	4·72	1,860
20	·042	47·2	·375	2·675	1,510
21	·038	57·5	·58	1·72	1,190
22	·034	72·0	·945	1·06	913
23	·030	92·5	1·65	·605	670
24	·028	106	2·26	·442	563
25	·026	123	3·175	·315	465
26	·024	144	4·6	·217	376

The constants shown were calculated on the slide rule, and are not given as absolute values ; they are, however, sufficiently near for obtaining fairly accurate results.

THE DETERIORATION OF CURTIS RATEAU TURBINE BLADING.*

(*Concluded from page* 503).

Two final cases are interesting on account of the rapidity with which deterioration takes place, and also because the machines are of later design than those previously described. The first of these is one of the 12,000-KW. generator turbines installed at Brakpan, containing 11 guide blade diaphragms. The first five stages on this set have been subjected to heavy pressure, so much so that displacement of the diaphragms has occurred. It would appear that steel, containing no nickel, 3 mm. thick, will give better results than the 2 mm. 30 per cent. nickel steel, although it is strange that in diaphragms 2, 3, and 4 the latter material shows no cracks.

The other case is on the three large compressor turbines of 10,000 H.P. installed at Rosherville.

The following table shows the arrangement of blades and condition when examined after the number of running hours specified. "H" signifies steel containing no nickel, and "J" 30 per cent. nickel steel :—

10,000-H.P. COMPRESSOR TURBINES.

Diaphragm.	No. 7. 10,362 hours.	No. 8. 11,543 hours.	No. 9. 5,994 hours.
No. 1 ...	"H." steel good.	"H." steel good.	"H." steel good.
No. 2 ...	"	"	"
No. 3 ...	"J." cracked.	"J." badly cracked.	"H." good.
No. 4 ...	"H." good.	"J." badly cracked.	"J." slightly cracked.
No. 5 ...	"J." good.	"J." cracked	"J." good.

The above results point to "H" steel being a much more suitable metal for guide blading than "J" steel.

Conclusions.—In summarising the behaviour of the materials used in blading these turbines, it will be seen that there is no difficulty in choosing a material for moving blades which can be depended on to give fairly satisfactory results in particular stages. Five per cent. nickel steel, brass and aluminium bronze in suitable stages will have a life of 40,000 hours, and, perhaps, 50,000 or more, which, if the turbines are run continuously, means five or six years.

Nozzles with thin cast-iron vanes should be abolished, but if cast-iron is used the design should be such that there is no possibility of pieces becoming detached.

The guide blading in use on these turbines is clearly unsatisfactory; three years or more must often elapse before this is discovered, and an equivalent time is taken to prove the success or otherwise of any alteration.

While the author feels that mild steel is preferable to the high percentage nickel steel in use, it must be admitted that the latter has given good results in many cases.

High percentage nickel steel has been more extensively used and for a much longer period than non-nickel steel. The evidence is, however, very much in favour of mild steel.

Blades made from brass sheet and carefully fitted to retaining rings have been used for small turbines. The cast-in method of attaching blades is very simple, and requires a minimum amount of machining and fitting, so that it would be preferable to retain this design if satisfactory results can be obtained.

The author believes that the position can be much improved by the use of thicker blades of mild or low percentage nickel steel, say, 3/16 in. or ¼ in., tapered, perhaps, on the outlet side to ½ in. Unfortunately, an alteration of this kind on a ring designed for 2 mm. blades reduces the area for steam passage somewhat.

In the case of the guide blade diaphragms for the 10,000-H.P. compressor turbines, the blades have been increased in thickness from 2.25 mm. to 3 mm. in three diaphragms on one turbine without affecting the efficiency or output.

On the 12,000-KW. generator turbines at Simmer Pan and Brakpan, six stiffening blades of mild steel, 3/16 in. thick, have been cast in each half.

On the same class of turbine cast-iron stiffening blocks are being cast between adjacent guide blades on the horizontal and vertical diameters of the diaphragm. This blocks up four ports in the complete ring, and should stiffen up the diaphragm very considerably.

The PRESIDENT (MR. BERNARD PRICE) said, whilst the statistics given were conflicting in some respects, he thought the following facts stood out as definitely proved :—

1. In the case of some blading materials high temperature contributes to deterioration.

The behaviour of aluminium bronze and high percentage nickel steel running blades in various stages pointed clearly to the fact that these materials were unsuitable for use at the higher temperatures.

2. The guide blading for the first three or four Rateau

* Abstract, from the *Proceedings* of the SOUTH AFRICAN INSTITUTION OF ENGINEERS.

stages is relatively immune from the deterioration so noticeable in subsequent stages.

This was, to his mind, a most striking fact; it appeared fair to argue that this cannot be attributed in any appreciable degree to the influence of temperature.

3. The first indication of the cracking of guide blades is always at the inlet side of the blade, and these cracks then extend cobweb fashion over the surface of the blade.

He ventured to suggest that the above-mentioned facts all pointed to axial movement of the diaphragms as being the primary cause of the loss of nature of the blading material. It would seem that the designer had relied upon the blades alone to withstand the forces acting on the diaphragms, and as these forces varied with the load on the machine a variable stress was set up in the high percentage nickel steel of which the blades were made. At the high pressure end of the Rateau stages the blades were relatively short in length, and it seemed reasonable to assume that up to about the fourth stage these blades were sufficiently strong and stiff to prevent any appreciable axial movement of the diaphragm, but beyond that stage this no longer held good.

There was a considerable amount of evidence to show that deterioration was more rapid on those machines which took a fluctuating load. Movements due to fluctuations in the load occurred continuously and rapidly, and their effect upon the molecular structure of the blading material would be many hundreds of times that caused by starting up and shutting down.

The Vereeniging machines ran steadily night and day, and the load they carried was a very steady one. The longer life of the guide blading at Vereeniging as compared with Rosherville was quite consistent with the argument he had put forward.

The large machines at Simmer Pan and Brakpan had been fitted with nozzle governors of a type which was much more sensitive than that in use on the other turbines. These machines, therefore, took up the major portion of the fluctuations of load, and this might very well have accentuated the trouble experienced on these sets.

The fact that the blades started to crack at the inlet side seemed also to support the theory that axial movement was responsible for the trouble. The shape of the blades was such as to place the inlet side in tension.

The cure for these guide blade troubles would, therefore, appear to lie in designing the diaphragms and guide blade rings so that axial movement was impossible.

It seemed to him that with suitable design deterioration should be confined to the effects of wear alone, and the problem appeared to be to find the hardest material which will withstand the temperatures existing in the Curtis and Rateau stages. Some of the metals at present in use appeared to withstand these temperatures quite satisfactorily, but they were relatively soft, and when iron alloys were used were subject to slight rusting at stages where the steam became wet. He had no knowledge of the molecular theory of alloys, but it seemed to him it should be possible to decide from theoretical considerations those combinations which were likely to be subject to molecular change under the influence of temperature, and, having eliminated these, selection could be made according to hardness and ability to withstand moisture. There seemed to be very little evidence of chemical action of gases in the steam; if it could be shown that, when using a given class of feed water, this danger was present, it might be necessary to eliminate also those alloys which would be expected to suffer from such chemical action.

In his opinion, the most important conclusion to be drawn from the paper was that the particular troubles dealt with were primarily due to axial movement.

ELECTRICAL INDUSTRIES IN CHINA.*

According to the Japanese journal, the *Zaisei Keizai Jiho* (Financial and Economic Review) for December, quoted in the February issue of the Shanghai *British Chamber of Commerce Journal*, the electrical industry of China is as yet in its infancy, and, as is natural, existing enterprises are confined almost entirely to large towns and open ports, seldom extending beyong urban districts. An idea may be gained of the state of her electrical industries from the fact that the aggregate capacity of electric motors in China is stated to be only 70,000 kw.

The number of electrical undertakings throughout China is 87, of which 62 are located in China proper, and 25 in Manchuria. Eighty of those enterprises are light or power services, or the two combined; four are such services carried on in conjunction with electric railways, while three are devoted to the manufacture of electrical apparatus and supplies. As for electric tramways, China proper (including Hong-Kong) has only three cities (Shanghai, Hong-Kong, and Tientsin) where these are maintained. The South Manchuria Railway Co. operates street railways at Dairen and Fushun, which are the only towns having such services in Manchuria. According to the latest data, the electric energy supplied for power and light throughout China totals 33,000 h.p. and 1,375,000 c.p. respectively. For purposes of comparison, it may be mentioned that the Hokkaido alone uses 35,000 h.p., while the city of Tokio and suburbs are served with 1,900,000 c.p. As a prime mover, steam power is almost exclusively employed in China, water power being utilised only in the Province of Yünnan.

Out of the 87 Chinese electrical undertakings, six are Chinese Government enterprises, 53 are managed by Chinese private individuals, while the remaining 28 are foreign undertakings. Some of the Chinese private businesses, however, are run with foreign capital, so that the enterprises really under Chinese private management are reduced to 41. Out of the 28 foreign undertakings Japanese interests number 10, seven of which are located in Manchuria. The number of kilowatts represented by the Chinese (both Government and private), foreign (Japanese excluded), and Japanese enterprises are 22,000, 31,000, and 17,000 respectively. As a rough estimate, for accurate figures are difficult to obtain, the capitalisation of the industry amounts to 36,000,000 yen (yen = 2s. 0½d.). Of this, foreign investments amount to 14,000,000 yen, and Japanese investments to 5,000,000 yen. Electrical enterprise in China has not yet attained such a stage of development as to yield satisfactory returns on the capital, only 13 businesses declaring an annual dividend of 5 per cent. There must, however, be room for economy in the cost of operation and maintenance, and with the general development of industrial and economic resources in that country this branch of enterprise is bound to expand.

The entire telegraphic service is controlled by the Ministry of Communications. At the end of 1913, telegraph lines extended over 37,403 miles, with 51,129 miles of wire. Submarine cables, with the exception of the Woosung-Canton line opened in the early part of 1915, are all under foreign control. The telephone service, inaugurated in 1903, consists of Government (both central and provincial) and private undertakings. The control of both telegraph and telephone systems is practically in the hands of foreigners, from the circumstance that these systems were constructed by the aid of foreign capital.

The electrical apparatus and supplies branch of the industry is almost non-existent, with the result that there is severe competition in the Chinese market for the sale of apparatus and supplies. Before the war Germany occupied the first position, the United Kingdom the second, and Japan came third in the value of goods of this class imported into China. Since then a considerable change has taken place, with a consequent increase of imports from Japan and the United States. The following figures show the early effect of the war on imports in this line from different countries:—

Imports of Electrical Apparatus, &c., into China.

From	1913. Hk. taels.*	1914. Hk. taels.*	1915. Hk. taels.*
United Kingdom ...	596,472	735,870	403,851
Germany	845,422	735,884	1,412
Japan	392,749	688,140	845,053
Hong-Kong	173,980	243,976	259,602
United States	179,079	134,733	285,010
Belgium	70,515	70,633	8,428
Other countries ...	148,873	185,181	281,683
Total	2,407,070	2,794,417	2,085,039

The growth of electrical industries, no less than other enterprises requiring the introduction of foreign capital, is hampered by the scarcity of funds occasioned by the war. On the return of peace, however, severe competition is expected to ensue in regard to electrical development in China. The activity of United States capitalists in China is remarkable, and they have formed, it is said, a combination for exploiting the light, power, and tramway services in the principal towns.

* *Board of Trade Journal.*

* The average value of the Haikwan tael was 3s. 0½d. in 1913, 2s. 8¾d. in 1914, and 2s. 7¼d. in 1915; 100 Haikwan taels = 111.40 Shanghai taels, for which exchange quotations are made.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Kingsway" Miners' Electric Hand Lamp.

The General Electric Co., Ltd., of London, have introduced an electric hand lamp for use in mines, which has been approved by the Home Office. The chief points considered in developing this lamp have been efficiency of illumination over the full run of 9 or 10 hours, together with strong construction, durability of parts, and freedom from corrosion.

The accumulator is of the absolutely non-spillable type, and the lamp can be put in any position for any length of time without the least chance of acid escaping.

The terminals and switch arrangements have been specially designed to minimise corrosion, particularly during charging, and

there are no springs of any kind attached to the accumulator, the terminals of the accumulator being made of solid pieces of non-corrodible material.

The spring-controlled switch contacts are also of robust construction, consisting of strong flat springs with the upper ends screwed to the lampholder, the lower ends having the switch knobs riveted into them. No celluloid is used in the switchgear.

The lampholder is provided with an adjustable conical reflector to come below the lamp, and another conical reflector is supported on top of the lamp bulb. These reflectors are of polished nickel, and are so shaped that they considerably increase the illumination in the horizontal direction.

In addition, a patented external reflector can be fitted, consisting of a curved nickelled reflector, which, when not in use, snaps on to the lamp case, and when in use partly surrounds the globe, concentrating the light over an angle of about 90°. The use of

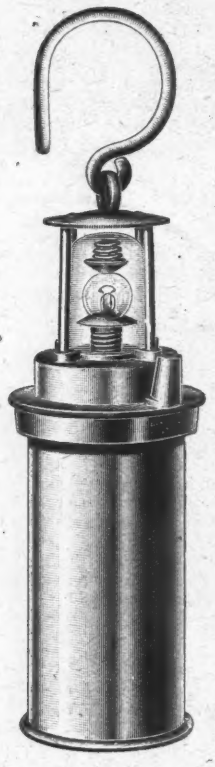

Fig. 1.—The Kingsway Miners' Lamp.

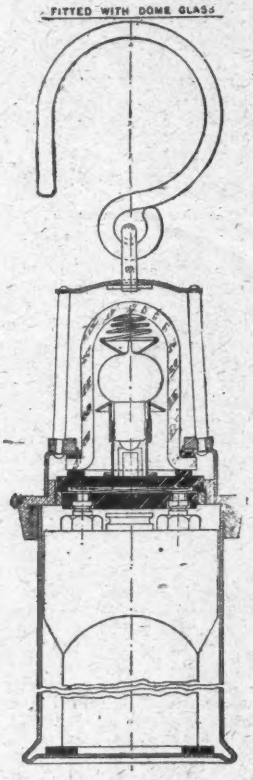

Fig. 2.—Sectional Elevation of Lamp.

this external reflector has also the advantage, when lamps are being carried to the working face, of shielding anybody walking behind from the glare of the lamp.

The leaded steel case is fitted with a strong threaded sleeve, which screws into the head of the lamp. The head is built on a strong brass casting, and is provided with a magnetic lock of simple construction. No parts of this lock are accessible when the head of the lamp is screwed on, but when it is off, the removal of one screw allows the bolt and controlling spring to be removed and examined, the total number of parts for the lock being the bolt, the spring, and the aforementioned screw. The general arrangement of the lamp is shown in figs. 1 and 2 herewith.

Copper-Plating Propeller Blades.

Wooden propeller blades for aeroplanes, &c., are now being coated with a thin layer of copper. This process of electroplating copper on wood (or other materials if desired) is by no means new, but has never before been used for the above purpose, and the work is only in the experimental stage.

The advantages of copper-plated propellers are numerous. They are stronger and give a better cutting surface, they will not become ragged-edged, they are protected from brush, &c., upon landing, and they possess many other advantages of less importance.

Excellent results in copper-plating wood are attained as follows:—Render the wood impervious to fluids by saturating it in a solution of wax or stearine varnish, then give it a coat of thick linseed oil varnish. Repeat this process until the mould is considered sufficiently impervious. Now coat the wood with a thickly fluid solution of shellac in alcohol and allow it to become thoroughly dry; then place it in a silver nitrate solution of four parts water and six parts alcohol. Drain off all excess nitrate solution. Place the article for a few minutes in a closed vessel containing hydrogen sulphide fumes. This coats the article with a thin coat of silver sulphide. Repeat this process twice.

After having performed the above preliminary work, proceed to copper-plate in the usual manner. The following solution mixed with water to make 100 quarts gives best results:—

44 lb. copper sulphate,
13·2 lb. sulphuric acid at 66° Be'.

Use about 20 amperes at start, working gradually up to about 75 amperes at 4 or 4·5 volts.—*Scientific American.*

The Cambridge Thermo-Couple Potentiometer.

The accompanying illustration, fig. 3, shows the latest form of the thermo-couple potentiometer made by the Cambridge Scientific Instrument Co., Ltd., of Cambridge, for the accurate measurement of small differences of potential not exceeding 90 millivolts. It is intended specially for use in temperature measurement by means of thermo-electric couples; the value of the unknown potential difference is determined by comparison with the E.M.F. of a Weston standard cell, readings being obtained directly in millivolts and fractions of a millivolt. Each division on the slide wire corresponds to 0·005 millivolt and is approximately 1 mm. long, so that by estimation readings can be obtained to one microvolt.

An accumulator cell supplies the current to the main circuit, which includes the adjustable resistances R_1 and R_2, two resistance coils, the graduated wire S S, the resistance coils marked M V C, and the graduated slide wire V V. The plugs D_1 and D_2 in this circuit enable ranges of 0—30, 30—60, or 60—90 millivolts to be obtained.

The wire S S is graduated so that the reading shown at any point N on its length is equal to the potential difference between that point and a point M in the circuit, provided the fall of potential in the main circuit is exactly 1 volt per 100 ohms circuit resistance; by moving the slider N along the wire S S the potential difference between M and N can be adjusted to correspond to the E.M.F.'s of different Weston normal cells. With the aid of a standard cell the resistance of the main potential circuit can be varied by means of R_1 and R_2 until the fall of potential in the main circuit is exactly 1 volt per 100 ohms circuit resistance.

The coil M V C is a continuous coil in 29 sections, each of which has a resistance of exactly ·1 ohm. On the basis of 1 volt per 100 ohms the fall of potential in each section is thus 1 millivolt. Similarly, the resistance of the slide wire V V being ·12 ohm, the fall of potential along its length is 1·2 millivolts. Thus in the

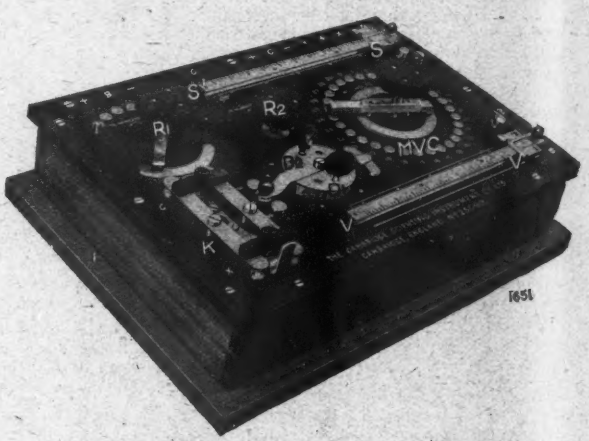

Fig. 3.—Cambridge Thermo-Couple Potentiometer.

portion of the circuit including the millivolt coils and the slide wire there is an available fall of potential of 30·2 millivolts. Therefore the E.M.F. of a thermo-couple, or other source of E.M.F. less than 30 millivolts in value, can be measured in millivolts given by the reading on the millivolt coils M V C, and the fraction of a millivolt determined by the graduation on the slide wire.

If it is desired to measure a potential difference between 30 and 60 or 60 and 90 millivolts, the plugs D_1 D_2 must be moved into the positions corresponding to this range.

The double key K is designed so that the galvanometer can be put in circuit either with the standard cell or the unknown potential difference; by pressing the contacts at c the circuit of the cell is completed through the galvanometer, and by pressing the contacts at x the circuit of the source under test is similarly completed. It is thus possible when measuring the unknown P.D. to test the accuracy of the fundamental adjustment for the standard cell without disturbing any of the connections; it is also possible by locking the contacts at x to follow the variation of a variable P.D.

Improved Finger-Contacts for Electrical Apparatus.

The usual way of making finger-contacts is to fix a carbon contact block rigidly in the free end of a spring finger, whose other end is securely held in a fastener. The requisite yielding pressure of the carbon block on a co-operating contact-piece is thus obtained by the resilience of the finger carrying the block. In practice these fingers may break, or else the block-end of the finger may bend up, causing bad connection, heating, and arcing. Mr. G. S. Haslam, of Balmoral, Cranleigh Drive, Leigh-on-Sea, has sent us particulars of a contact-finger which, he claims, is unbreakable: the carbon block is carried on the

free end of the finger, and is hinged to its support. The requisite pressure is obtained by a separate steel spring bearing on the finger. A flexible copper connector bridges the hinge to ensure conductivity.

These fingers, of which one is illustrated in fig. 4, are easily

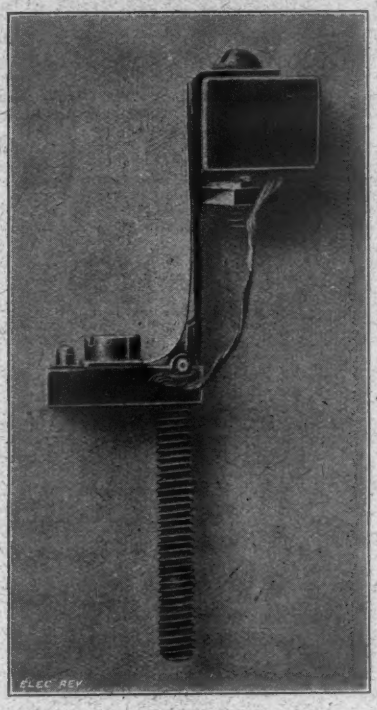

Fig. 4.—Improved Contact Finger.

taken apart from the front of the rheostat and a new spring can be fitted in a few moments. They have been thoroughly tested, and have proved very satisfactory. The inventor has applied for letters patent.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wiring with Tough Rubber Compound Cables.

Your readers, after perusing the article contributed by Mr. W. Ellerd-Styles, A.M.I.E.E., and also the letter by "Another Member of the E.A.C.," on the above subject, may now be interested in the views of one with a wider perspective. Any suggestion for improvements that will tend to increase the business of the supply undertakings, without impairing the efficiency of the installation, will be heartily welcomed by central-station engineers responsible for its development. It is very generous of your contributor to offer to instruct the supply authorities' representatives, and no doubt there are many who will avail themselves of his generosity—when there is some indication that he can do so.

In advocating any system, one would think that the first essential is a varied experience to enable the advocate to discriminate where and how it could best be adopted to meet certain conditions, where other methods have failed. There may be several classes of work where it would be advantageous to use it; cannot these be specified? To suggest seriously that by its use a permanent waterproof system may be effected is trifling with the intelligence of your readers, especially when it is stated that this can be accomplished by the insertion of rubber washers in the nipples of switches, &c.

"Another Member, &c.," suggests "that the best plan is to *enclose* it in short lengths of light steel conduit of ample size," and also that a junction box of more substantial and better design, "preferably fireproof," be provided, for fixing under floors, &c. He has also heard that "where exposed to the sun's influence . . . . the sheathing has been found to crack open in a very short time." If this be true it is sufficient justification for the attitude adopted by "most of the insurance companies," and more especially the engineers responsible to the supply undertakings, who may be excused if they conclude that the suggestion, to use this cable for all purposes, is a sort of "curate's egg" counsel, prompted by the limitations of the ostrich's vision.

Without detracting from the many advantages of this cable for the uses for which it was originally intended, it cannot be accepted as good practice to increase the bulk of the dielectric to replace the mechanical protection so often necessary throughout the widening field of electrical application. The best preservative for all cables is discrimination applied only by those who have acquired it in the field of experience.

Consumers' Engineer.

This article, in your issue of 27th ultimo, is very interesting, both from the "wiring system" and from the switching points of view.

The only fault we can find is the use of turn switches on some of the circuits. The superiority of the tumbler as compared with the turn method of actuation is so obvious that it is needless to explain it. And in the cases under notice tumbler switches are available which will do all that the turn switches accomplish.

Passing by the fact that the American names "2-point switch," "3-point switch," are more or less meaningless,

A. P. Lundberg & Sons.

London, N., *May 2nd*, 1917.

Electric Vehicles.

The letter published last week from Mr. Rowley would seem to indicate that the electric vehicle is in an experimental stage, and that no thought has been given to any question of standardisation of its parts.

The fact that this is not so cannot be too often stated, even if it is only to ensure that such men as Mr. Rowley shall not write to the Press on matters which they are evidently not familiar with, and thereby damage the free development of the electric vehicle.

The battery for use in electric vehicles has been standardised now for over three years, both with regard to number of cells (*i.e.*, charging voltage) and external dimensions. So far as capacity goes, this cannot be standardised, nor is it wanted, for the capacity is fixed by the load to be carried, and the class of work done, as well as by the mileage to be covered.

The list given, in the publication of the Electric Vehicle Committee, of electric charging stations indicates that at least batteries can be charged at quite a number of central stations throughout the country, and, as the charging plug has been standardised for years, any "electric" can get attention for the asking at fixed and published rates.

Mr. Rowley talks of his big car, and a tour from Avonmouth to Newcastle; does he realise that "electrics" are not made for touring, and the conditions which he specifies ought not to occur at all, but that he should either travel by train, or, if he wishes to see the country, take a petrol touring car?

His idea of the "electric" wants bringing up to date, and he could not do better than take a tour to Birmingham, Bradford, London, or any other big town, and learn what an "electric" is, and what it will do; he would probably be surprised to find that hundreds of "electrics" are in use, and that they can show operating costs which give neither the horse nor the petrol truck a "look-in" for short hauls up to about 100 miles per day; above this figure, except under special conditions, the petrol van, or the railway, is the better means of transport.

Semper Ipsi Este.

Manchester, *May 7th*, 1917.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Report.

The report of the Council, to be presented at the annual general meeting of the Institution on May 17th, is printed in the *Journal* for April. It shows that the membership at April 1st numbered 6,613, a net reduction of 63 on last year's total; in addition, 26 candidates for Associate Membership have been approved by the Council during the year, subject to their satisfying the examination regulations. Under the new Articles of Association 41 alien enemies have been removed from the list of members. Numerous military distinctions have been awarded to members during the year, including 58 decorations and 108 mentions, and 39 members have lost their lives in the service of their country.

The following premiums for papers have been awarded by the Council (value £10 each):—

Ayrton Premium: G. V. Twiss, "High-tension Overhead Transmission Lines."

Fahie Premium: F. R. McBerty, "Machine-switching Telephone Gear."

Paris Premium: C. Vernier, "Wayleaves."

Extra Premium: F. Gill and W. W. Cook, "Principles Involved in Computing the Depreciation of Plant."

Extra Premium: S. P. Smith, "The Theory of Polyphase Armature Windings."

A number of suggested alterations in the Wiring Rules have been submitted for the consideration of the Committee, but it is not proposed to undertake a further general revision until after the war. In the meantime, a sub-committee has been appointed to collect evidence with regard to the use of lead-covered conductors for house wiring. A committee was appointed last May, under the chairmanship of Mr. C. H. Wordingham, to draw up regulations for electrical installations on ships other than warships, and the regulations will be published in the course of a few months. The Standard Specification for Street Lighting will also be published shortly, as a majority report of the special committee appointed for this purpose.

The research on the heating of buried cables has continued, the expenditure during 1916 being £960, of which £840 was provided by the Government Department for Scientific and Industrial Research. Tests on insulating oils are also in progress, the outlay having been £356, of which £250 was provided by the Research Department. Schemes of research have been prepared in respect of various insulating materials, with a view to drawing up standard specifications; the B.E.A.M.A. will collaborate in this research, dealing mainly with its industrial aspect, while the Institution will carry out the scientific part of the work. The Committee on Electricity Supply has held six meetings, and has kept in close touch with the Joint Committee appointed by the I.M.E.A. and the I.A.E.P.C. The Institution Committee has arrived at a decision with regard to the adoption of standard frequencies for certain large areas, and is considering the voltages that should be recommended for transmission and distribution, and the question of obtaining reasonable facilities for wayleaves. The Committee has been awaiting the publication of the report of the Electrical Trades Committee of the Board of Trade, with a view to working along the lines which the report is expected to indicate, but when the report will appear is uncertain, especially in view of the recent appointment of an Electric Power Supply Committee by the Board of Trade, and it is considered likely that some time will elapse before definite recommendations can be made by the I.E.E. Committee.

The number of members serving, or having served, in the Forces since the outbreak of war is 1,671. During last year the President, at the request of the Authorities, nominated a number of electrical engineers for commissions as Lieutenants, R.N.V.R., for electrical duties on battleships and as equipment officers in the Royal Flying Corps. The classes which have been in progress at the Northampton Polytechnic Institute since June last year have been attended by 111 disabled sailors and soldiers, of whom 91 have been placed in situations and 96 approved for employment. Over 230 applications for men were received from employers. The Committees of Local Sections are co-operating, and men are under instruction in Manchester, while progress has been made at Birmingham, Leeds, and Newcastle. On the invitation of the Ministry of Labour, the Council has appointed a special committee to assist in carrying out an investigation with regard to openings in the electrical engineering industry for disabled fighting men.

The issue of a memorandum by the Reserved Occupations Committee with regard to substitution in electrical generating stations led the Council to point out the risk to the nation that would be involved by failure to maintain the supply of electricity through the skilled operating staff being reduced below a safe limit, and the Committee invited the Council to organise a deputation of representatives of supply undertakings to discuss the position with i . The deputation, consisting of 14 members, on March 28th was introduced by Mr. C. P. Sparks, and drew attention to the small amount of labour employed by supply undertakings compared with the number of employés working in factories depending upon electric power supplied by them, as well as the economy of fuel effected by the use of electric power. The Chairman of the Committee stated that although some of the undertakings might have done all that was possible, the Committee wished to bring all into line, and requested the deputation to consider what additional classes could be replaced by women, to ascertain to what extent substitution had been made, and to be prepared to attend another conference in three months.

The accounts show an excess of income over expenditure of £3,777, compared with £1,847 in 1915. Mortgages, reduced by £772, stood at £32,719. The Life Compositions Fund stood at £5,257. The assets were valued (less depreciation) at £120,799, and the liabilities at £42,610, leaving a balance to the good of £78,189, an improvement of £4,454.

Electric Zinc.—Mr. Hughes, the Commonwealth Prime Minister, states that the electrolytic spelter works at Hobart will cost £1,000,000, Great Britain lending half. There will be sufficient zinc concentrates retained in Australia to keep the works employed at full pressure.—*The Times.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,644. "Lanterns or casings for incandescent electric lamps." Wardle Engineering Co. & H. T. Wilkinson. April 23rd.

5,663. "Dynamo-electric machines." C. L. Breeden & H. Lucas. April 23rd.

5,693. "Magnetometer for measuring weak magnetic fields." Valente da Cruz, J. L. April 23rd.

5,706. "Sparking plugs." T. F. Burley & H. Coxon. April 24th.

5,738. "Wireless signalling systems." British Thomson-Houston Co. and General Electric Co. April 24th.

5,778. "Heating elements for electric radiators, &c." O. Bathke. April 24th.

5,788. "Reflectors for electric flashlamps, hand lanterns, pocket lamps, &c." W. D. Fox. April 25th.

5,801. "Electric light fittings." B. Thomas & E. Thomas. April 25th.

5,804. "Apparatus for detecting and magnifying minute electric impulses." T. Harvey. April 25th.

5,811. "Dynamos." W. Kingsland. April 25th.

5,815. "Switches for miners' electric lamps." W. H. Davis and J. Davis and Son. April 25th.

5,825. "Centrifugally-actuated short-circuiting devices." British Westinghouse Electric & Manufacturing Co. April 25th. (U.S.A., May 3rd, 1916.)

5,843. "Magneto-electric machines." T. H. Cleathero & F. Spurr. April 25th.

5,973. "Arrangement and construction of aerial propellers for driving dynamos, &c., on aircraft." A. H. Stark. April 26th.

5,898. "Means for cleaning sparking plugs of internal-combustion engines, &c." J. H. Andrew. April 26th.

5,941. "Electric switches." H. B. Butler. April 27th.

5,984. "Electric lamps for projection apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 27th.

5,993. "Electromagnetic detecting or indicating apparatus." F. W. Dodd. April 27th.

6,019. "Section insulator for overhead electrical equipment." H. Burton and J. Whelan. April 28th.

6,023. "Electrophones." S. M. Hyman & Stolz Electrophone Co. April 28th.

6,036. "Electric multiple switches." E. A. Laidlaw. April 28th.

6,046. "Plates, slabs, &c., for electric insulation." P. J. Pybus. April 28th.

6,050. "Electrical arrangements for facilitating starting of internal-combustion engines." J. W. T. Cadett & C. Percy. April 28th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

4,780. Process for the Electrolytic Deposition of Zinc on Metallic Surfaces. P. Marino. March 31st, 1916. (105,255.)

4,827. Electromagnetically-operated Switch. A. P. Turnbull. April 1st, 1916. (105,257.)

5,325. Semi-automatic Telephone Exchange Systems. Western Electric Co., G. Deakin & L. Polinkowsky. April 11th, 1916. (105,266.)

5,875. Intercommunication Telephone Systems. J. W. Dungey. April 25th, 1916. (105,272.)

8,334. Detonators or Fuses for use with Grenades, Shells, Mines, or the like, and Explosives generally. F. S. Denison. June 13th, 1916. (105,283.)

8,453. Glass-working Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 15th, 1916. (105,285.)

8,551. Means for Securing Globes, Shades, Reflectors, and the like on Electric and other Lamps. J. Cook & J. Clegg. June 17th, 1916. (105,288.)

8,736. Electric Switches. T. P. Casotti. June 21st, 1916. (105,291.)

9,608. Method of and Apparatus for Evacuating the Bulbs of Electric Incandescent Lamps and other Glass Vessels. Deutsche Gasgluhlicht Akt. Ges. (Auerges). September 27th, 1915. (101,621.)

16,144. Construction of Magneto-electric Machines. G. F. Cooke. November 10th, 1916. (105,310.)

77,206. Electric Circuit Interrupting Systems. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). November 30th, 1916. (105,314.)

18,553. Electrolytic Production of Oxygen and Hydrogen. G. F. Jaubert. December 29th, 1915. (102,974.)

Technical Study.—According to the *Birmingham Daily Post*, an interesting experiment is being made by the Austin Motor Co. by the formation of a technical society at the works, having as its object the promotion of the study of engineering and other branches of applied science, and to provide a means for the interchange of ideas and information between its members. It is proposed to hold frequent meetings, at which papers of special interest will be read and discussed, and lectures illustrated by the works lantern and kinematograph will also be arranged for.

Engineering Organisation.—*Empire Trade Notes* says that a further stage in the formation of plans for the furtherance of British engineering interests after the war is marked by the decision of the British Engineers' Association to affiliate to the British Empire Producers' Organisation, which has strong connections amongst associated industries of the Dominions and Colonies. The alliance between the great Oversea producers and the British engineering manufacturers is stated to possess reciprocal advantages.